

Des Moines Disconnected: Uniting the Metro Through Public Transportation Options

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Sarah Anderson
Igor Hadzisulejmanovic
Annie Hoffmann
Derma Rivera
Ryan Yashack
Yue (Iris) Yin

Allen Zagoren DO, MPA (Professor)

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Abstract

Des Moines has become a city disconnected from its metropolitan suburbs. As the metro area has expanded, the growth has been limited primarily to the suburbs. While the downtown has experienced an “urban renaissance” in the past decade, citizens continue to report that they don’t go downtown because of parking issues and the fact that they can do or buy the same things more conveniently in their own suburb.

This paper examines the history and economic conditions that led to this problem and seeks to propose a long-term option to address it: expanding the public transportation system and modifying it to incorporate the benefits of a hub-and-spoke model. In the course of this analysis, the authors conducted a survey of Des Moines and suburban residents to determine their attitudes regarding downtown and public transportation options. They also compared Des Moines to several other Midwestern cities with more mature transportation systems.

The proposed changes to the system include designating High Occupancy Vehicle (HOV) lanes on metro interstate highways and upgrades to the bus system that could be incorporated into the current Des Moines Area Regional Transportation (DART) authority’s long-term plan, DART Forward 2035. In addition, the team suggests that the Des Moines Area Metropolitan Planning Organization should reassess the feasibility of a light rail system and/or an electric streetcar system.

Introduction

Much like cities throughout the country, Des Moines has seen its population shift from urban to suburban over the past fifty years. Not only have people chosen to live outside the city limits, but local businesses have also opened to support them, and major companies have elected to build their headquarters in the more-affordable suburbs. As this happened, the suburbs became more self-contained; residents could live, work, shop, and be entertained within their own suburb.

Downtown Des Moines started to have vacant storefronts and become deserted after business hours.

The tide has turned, however, and Des Moines is experiencing an urban revitalization. In 2014 alone, Des Moines was given consistently high rankings by the following publications and organizations:

- *Forbes*: Best City in US for Young Professionals (Carlyle, 2014)
- *MarketWatch*: Top 10 City for Younger Home Buyers (MarketWatch, 2014)
- *Forbes*: #2 Best Place for Business (Badenhausen, 2014)
- *Fortune*: #1 City with Up-And-Coming Downtowns (Gallagher, 2014)
- *RealtyTimes*: Top 6 Most Family Friendly U.S. Cities (Wyher, 2014)
- *Vocative*: #4 Most LGBT-Friendly City in America (Nichols, 2014)
- *Policom*: #1 Region for Economic Strength (Fruth, 2014)
- *Forbes*: Number 6 to Raise a Family (Owen, 2014)
- *ZipRecruiter*: Top 5 Cities for Finding Jobs (Garner, 2014)
- *Paste Magazine*: Top 10 Undercover Stylish Neighborhood in the US (Andrew, 2014)
- Healthways and Gallup: 25th for Overall Well-Being (Gallup and Healthways Well-Being Index, 2014)
- Brookings Institution: Top 10 Nationally for Teen Employment Rate (Sum, 2014)
- *Des Moines Business Record*: Top Midwest Economy (Oppenhuizen, 2014)
- *TODAY show*: #1 Wealthiest City in America (Tibbles, 2014)

In order to sustain a vibrant downtown, Des Moines must encourage people to live, work, and play there. Businesses must be able to see downtown Des Moines as an optimal choice in comparison to suburban locations, and area residents must see the downtown as a desirable destination for work, recreation, and entertainment. In order for this to happen, Des Moines must have affordable, fast, and reliable transportation networks to connect the downtown to its suburbs.

History

Des Moines was the second city in the nation (after Richmond, VA) to have electric streetcars. These first lines, built in 1888, ran along Locust Street and Grand Avenue. As developers built outward into the suburbs, they extended the rail and trolley lines. Often, the developers built the lines to support the sale of their projects, but the rail lines themselves ran at a loss until being acquired by utility companies (Iowa Department of Transportation, 2014).

However, in the Great Depression of the 1930s, sales of personal automobiles had slumped, so General Motors adopted a strategy to acquire public transportation systems and convert them to busing systems. General Motors' parent company could then provide the diesel-fueled, rubber-tired buses to sustain the company until personal automobile sales recovered. After WWII, as General Motors reallocated its resources to building personal automobiles, the public transportation lines fell into disrepair. The inefficient and unreliable bus system further encouraged citizens to purchase personal vehicles, so General Motors had no incentive to improve the system (Iowa Department of Transportation, 2014).

The Urban Mass Transportation Act of 1964 provided grants to help local communities buy out the failing transit systems, and the Des Moines transit system became publicly owned and operated in 1973 (Iowa Department of Transportation, 2014).

Economic Development

In the 1990s and early 2000s, businesses flocked to the Des Moines suburbs – particularly West Des Moines. The Jordan Creek Mall opened in 2004 along with Wells Fargo’s 160-acre office complex. Athene USA (formerly Aviva USA) followed suit in 2011 with a 373,000 square foot high-rise office building a block away (Meinch, 2014).

The Greater Des Moines Partnership, the Metropolitan Planning Organization (MPO), and the Des Moines Community Foundation have collaborated to produce a short-term plan for Central Iowa called “Capital Crossroads” and a long-term vision for the Greater Des Moines area called “The Tomorrow Plan.”

The Capital Crossroads strategic plan calls for investment in six industrial sectors:

- Finance & Insurance – Des Moines is an insurance hub with 81 insurance company headquarters, employing 16% of the region’s workforce.
- Information Solutions – Des Moines has attracted major tech companies like Facebook and Microsoft because of its strategic and cost-effective location for data center operations.

- Health & Wellness – “Leverage a comprehensive wellness campaign to create economic opportunities in Central Iowa, change perceptions of the region through marketing of the initiative and its components, and retain and attract businesses and talent in health and wellness and other target sectors.”
- Agribusiness – Called the Cultivation Corridor, the area has access to raw materials, research institutions, a talented workforce, and proximity to customers.
- Advanced Manufacturing – The manufacturing sector in Des Moines is reinvesting in local operations and growing in strategic subsectors.
- Logistics –With a central location and immediate access to Interstates 80 and 35, Des Moines is well-positioned for warehouse and distribution facilities.

While neither the Capital Crossroads nor the Tomorrow Plan specifically reference public transportation as an engine to economic growth, several studies published in the last ten years have studied the relationship. A study by Todd Litman (2012) of the Victoria Transport Policy Institute points out that cities with large rail systems significantly outperform cities with bus-only systems.

Compared with Bus Only cities, Large Rail cities have:

- 400% higher per capita transit ridership (589 versus 118 annual passenger-miles).
- 887% higher transit commute mode split (13.4% versus 2.7%).
- 36% lower per capita traffic fatalities (7.5 versus 11.7 annual deaths per 100,000 residents).
- 14% lower per capita consumer expenditures on transport (\$448 average annual savings).

- 19% smaller portion of household budgets devoted to transport (12.0% versus 14.9%).
- 21% lower per capita motor vehicle mileage (1,958 fewer annual miles).
- 33% lower transit operating costs per passenger-mile (42¢ versus 63¢).
- 58% higher transit service cost recovery (38% versus 24%).
- Improved fitness and health (since most transit trips have walking or cycling links, so transit travelers are much more likely to achieve physical activity targets than motorists).
- More money circulating in local economies (since transit users spend significantly less on vehicles and fuel, and tend to spend the savings on other goods with more local input).

While the past two decades have seen headquarters and major building sites for these types of companies move to the Des Moines suburbs, recent announcements indicate that a “downtown renaissance” may be on the horizon for downtown Des Moines. In early 2014, Kum & Go announced that it would move its headquarters from West Des Moines to downtown Des Moines and build a new headquarters near Western Gateway Park. Other recent significant projects that have taken place downtown include:

- Wellmark Blue Cross Blue Shield opened a new \$250 million campus in 2010.
- Nationwide built a \$280 million campus in 2008.
- Principal Financial Group began a \$400 million renovation of its campus in 2014.
- Fidelity & Guaranty Life Insurance Co. moved its headquarters to an existing building in Downtown Des Moines, employing 50 people (Aschenbrenner, 2014).

Finance, insurance, and biotech are the dominant industries in the Greater Des Moines area. Approximately 70,000 people, or nearly 25 percent of the area's workforce, work downtown, according to the Downtown Community Alliance. Des Moines and the surrounding suburbs are home to more than 35 companies with 1,000 or more employees (Downtown Planning Project Steering Committee, 2008). This requires a great number of parking spaces as well as enough road space to commute each of these employees in and around the metro. With that being said, there are alternatives to driving oneself to work each and every day. Many individuals choose to carpool, some take the bus, others a taxi, and an ambitious few either walk, run, or bike to work.

To provide a work-life balance, many employers include a benefit for their employees to ride the bus at either a reduced cost or free of charge. This is a perk for both the employer and the employee. Such a benefit offers the employer the ability to recruit and retain employees, save on the need for parking spaces, and a tax deduction for providing such a benefit (DART, 2014).

The benefit to the employee is saving hundreds of dollars each year on their personal vehicles. Many think that it only saves on fuel; however, wear and tear to the actual vehicle is more than just fuel. It applies to tires, oil changes, insurance, car washes, and maintenance on the body of the vehicle. Not only can the monetary savings add up, but it can also save the individual the time and stress of the commute.

All of the previously mentioned benefits apply for both the employer and the employee. This may be the reason that there are at least 39 companies within the Des Moines metro that offer such a benefit to their employees through DART. After a few calls to the top employers (Wells Fargo, Principal Financial Group, Mercy Hospital, UnityPoint) in the metro, each state that parking is not an issue for their employees. This may be true as of now, but with the growth in the Des Moines metro, this may not be true for long.

Demographics

Much like any other metropolitan area, Des Moines has a number of suburbs. Ankeny, Altoona, Clive, Grimes, Johnston, Norwalk, Urbandale, Waukee, and West Des Moines are just a few of the suburbs that are very close. Unfortunately, there is a huge disconnect between Des Moines and each of the suburbs. The disconnect is that each suburb has grown so much that they are virtually independent of Des Moines. The question remains as to the ability to connect Des Moines with major suburbs and how to do so in a safe, speedy, convenient, and cost-effective way.

Central Iowa's Population Growth

Iowa's population has grown at a slow, modest pace over the past 113 years. In 1900, the population was 2.23 million; in 2013, it was 3.09 million, a change of about 38.5%. By comparison, Minnesota has grown more than 309% (1.75 million to 5.42 million) during the same period. Statistically, Iowa has not experienced much growth since the 2010 census. In fact, Iowa's population has only increased by

1.4% while America as a whole has grown by 2.4% during the same period (US Census Bureau, 2014).

While Iowa's overall population growth is under-pacing American growth, numerous cities in central Iowa are significantly outpacing American growth. Moreover, 75% of Iowa's population growth since the 2010 census has occurred in ten cities, seven of which are in central Iowa. The ten fastest growing cities in Iowa are: 1) Ames, 2) Ankeny, 3) Cedar Rapids, 4) Davenport, 5) Des Moines, 6) Iowa City 7) Johnston, 8) Urbandale, 9) Waukee, and 10) West Des Moines (Tibbetts, 2014). Of the ten cities, six are located in Polk (P), Dallas (D), or both counties (P/D). Ankeny (P) has grown by more than 13%; Des Moines (P) by 1.6%; Johnston (P) by 14.6%; Urbandale (P/D) by 5.9%; Waukee (D) by 23.7%; and West Des Moines (P/D) by 8% (US Census Bureau, 2014). Figure 1 depicts growth since 2010.

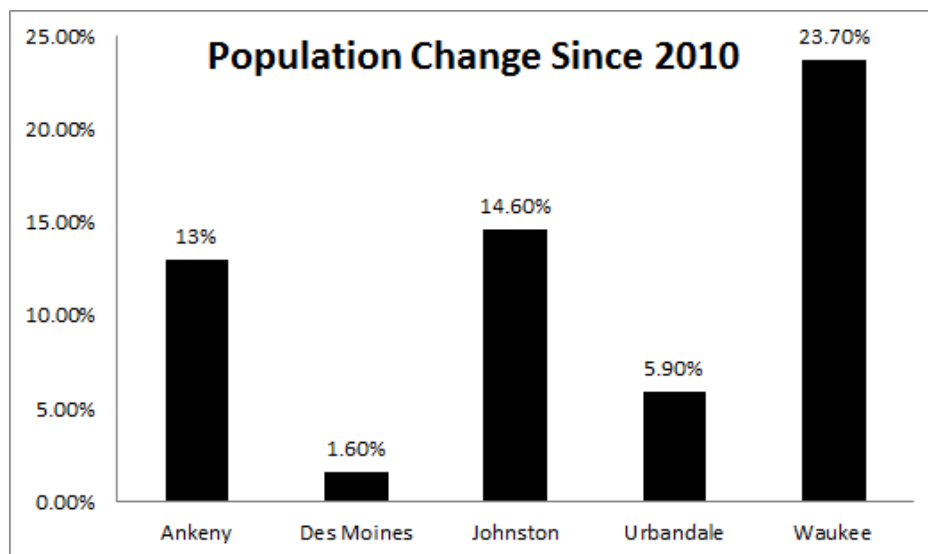


Figure 1. Population growth in Polk/Dallas County since 2010 census.

Des Moines' Population Growth

The city of Des Moines was incorporated in 1851 and became the capital of Iowa in 1857. By 1900 Des Moines had become Iowa's largest city with a population of more than 60,000, and population peaked in 1960 at 208,982. According to the U.S Census Bureau, the city still has not returned to that peak; the population of the city was 203,433 in the 2010 census (US Census Bureau, 2014).

While the Des Moines metropolitan area has continued to grow and prosper, the 1960s saw the beginning of a trend away from urban life. By 1980 the population of the city had bottomed out at 191,000 (US Census Bureau, 2014).

Growth in the suburbs is still outpacing growth within the city limits of Des Moines. The metro-area population is now nearly 570,000, which means that nearly twice as many residents live in the suburbs as in the city (US Census Bureau, 2014).

As a whole, the Des Moines area is a well-established community with a slightly diverse (as compared to the rest of Iowa) atmosphere. With the exception of the actual city of Des Moines at 17.7% below poverty level, all other suburbs come in at 7.1% or lower. Des Moines holds a fairly steady high school graduation rate for citizens 25 years of age and older at 86.5%, which falls just short of the state as a whole coming in at 90.7%. With that being said, only 24.5% of those individuals within the city of Des Moines go on to complete a bachelor's degree or higher. This ranks incredibly close to the state average at 25.3%. While a fourth of the citizens inside the city limits of Des Moines go on for a higher education after high school,

the average household income falls short of the state average by \$6,267. Iowa's average is \$51,129 and Des Moines is \$44,862 (US Census Bureau, 2014).

With a positive population shift of 1.6% the city of Des Moines went from a population of 203,433 in 2010 to 207,510 in 2013. In the metro area, the city of Des Moines has the most diverse population with 70.5% Caucasian residents. This is still a high percentage of Caucasian individuals compared to other races, but it is relatively diverse in comparison to Iowa as a whole, which consists of 88.7% Caucasians (US Census Bureau, 2014).

Des Moines is also one of the few cities within the metro that has experienced a low population shift. The reasoning behind this is that Des Moines is already surrounded by cities and does not have much room to expand. They have, however, been able to grow. The expansion of downtown and the condos and townhomes seem to be where all of the growth has happened. Downtown has not only grown in population, but with business that has drawn in those unfamiliar with the area.

Suburban Profiles

Altoona

Starting alphabetically with the suburbs of Des Moines, the city of Altoona has expanded by 7.6% going from 14,541 in 2010 to 15,653 in 2013. Altoona is just close enough to Des Moines, yet far enough away, that it is growing, but not as fast as other suburbs. Altoona is trying to increase their population by offering tax abatements on new properties as well as bringing in new businesses to the area (City of Altoona, 2014). Altoona has the Adventureland theme park and Prairie

Meadows Racetrack and Casino that bring in tourists, but they are looking to increase their regular population in the hope that too will bring in more tourists. From 2008-2012 Altoona's citizens had a higher rate than the state of Iowa when it comes to high school graduates 25 years and older with 96.5%, and a bachelor's degree and higher at 32.2%. In addition, the median household income is approximately \$16,000 higher than Iowa at \$67,120 (U.S. Census Bureau, 2014). Recently, many businesses that are established within the Des Moines city limits have expanded to another location in Altoona. This is convenient for those in and around Ankeny, Bondurant, and Altoona, but it disconnects these small suburbs from the Des Moines area. This disconnect could drive a wedge between the suburbs and the city, as suburban patrons no longer have a need to go downtown.

Ankeny

With a population shift of 13.1% from 2010-2013, Ankeny is the third fastest-growing suburb in the Des Moines metro. The reason Ankeny can grow so fast is the amount of land available to them on the north side of town. Because Des Moines and a few other suburbs are blocked in by other suburbs, they can only grow vertically. Ankeny has the freedom to expand with single-family homes that are more suitable to small and growing families. Ankeny also has high-ranking schools, number two in the state of Iowa according to neighborhoodscouts.com (2014), which assists in recruiting new families to the area. Ankeny also has a higher-than-Iowa average when it comes to high school graduates 25 and older at 97.4% and bachelor's degree completion at 47.2% from 2008-2012. Numbers like that equal a higher median

household income at \$73,622 (US Census Bureau, 2014). Much like Altoona, Ankeny has seen a rise in businesses expanding from the city with locations in the suburbs.

Clive

The city of Clive is growing slightly at 7.7% since 2010. With a population of 15,447 in 2010 and 16,590 in 2013, one can see that it is much harder for cities that are sandwiched within other suburbs to expand. With that being said, those suburbs in the metro are finding a way to do so despite the struggles with limited space. Much like Altoona and Ankeny, 2008-2012 high school graduate rates of those 25 and older is 94.8% and bachelor's degrees and higher is at 55.8%. The high percentage of those with an education contributes to the fact that the median household income between 2008-2012 is \$96,452, which is higher than the state of Iowa's average by almost \$45,000 (US Census Bureau, 2014).

Grimes

What was once considered a small town, as it has a school system paired with Dallas Center, Grimes has been growing and expanding to the north. Grimes has more room to grow, and it will likely continue to do so with its small-town atmosphere that many desire, paired with the closeness of the city. Growing from a population of 8,246 in 2010 to 9,335 in 2013, the suburb showed an increase of 13.2%. The rate of those 25 and older having graduated high school from 2008-2012 is 96.8%, and the percentage having completed a bachelor's degree or higher in that same time frame is 41.5%. Even with numbers like that, the median income in Grimes is \$62,331,

approximately \$11,000 more than the state-wide median income from 2008-2012 (US Census Bureau, 2014).

Johnston

With a population increase of 14.6% since 2010, Johnston is the second fastest-growing city within the metro. Neighborhoodscouts.com (2014) ranks Johnston schools as number one in the state of Iowa. Like the other suburbs already discussed, Johnston also has a high average of individuals 25 and older having finished high school, 96.9%, and bachelor's degree and higher at 54.4%. Numbers that are more than double the average of the whole state for bachelor's degrees and higher lead to a median household income of \$94,014 (US Census Bureau, 2014).

Norwalk

Norwalk is a slower-growing suburb, but with all businesses being local with the exception of two car dealerships, the residents in Norwalk tend to find work within the Des Moines area. In 2010 the population was at 8,945 and 9,639 in 2013, giving Norwalk a growth of 7.4% over three years. Having said that, Norwalk's median household income between 2008-2012 was still higher than the state of Iowa at \$76,429. Even though percentage of high school graduates at 25 and older is higher than the state average, 96.5% between 2008-2012, the rate of those finishing a bachelor's degree or higher, 33.3%, is not as high as some of the other suburbs, but is still slightly higher than the state of Iowa average (US Census Bureau, 2014).

Urbandale

Another sandwiched suburb of Des Moines, Urbandale, has had the least amount of growth over the past three years. A growth of 5.9% since 2010 is still growth, but compared to other suburbs, Urbandale seems to be falling behind. Nonetheless, they still had an upward shift in population from 39,463 in 2010 to 41,776 in 2013.

Urbandale falls in line with other suburbs, having higher high school graduation rates for those 25 and older from 2008-2012 at 97.4%, higher bachelor's degree and higher education from the same period at 48.2%, compared to the state-wide rate. The median household income is higher than the state of Iowa at \$83,134 between 2008-2012 (US Census Bureau, 2014).

Waukee

Waukee is the suburb with the most growth. Waukee has the land to grow, and they are using it. Families are flocking to Waukee, 23.7% from 2010 to 2013 to be exact. Waukee is still relatively small in numbers, only having a population of 13,790 in 2010 to a population of 17,077 in 2013. Small towns are attractive to some people, especially small towns that are close to the major hub of the city and that have a lot to offer. Waukee is booming, with new businesses as well as expansions of businesses already located within the metro looking to expand to a larger location. Like each suburb previously listed for the Des Moines metro, the median household income is higher at \$78,102. This could be the result of the higher high school graduation numbers, 96.5%, and the higher graduation numbers for a bachelor's degree, 51.7%, from 2008 to 2012 (US Census Bureau, 2014).

West Des Moines

West Des Moines is a rather large suburb offering not only a population of citizens to the area, but also business from local and corporate offices. With a population of 56,609 in 2010 and 61,255 in 2013, West Des Moines has grown 8.0% in the past three years. Much like other suburbs, West Des Moines offers a number of housing arrangements including single family homes, townhomes, condos, and apartments. As a community, they have learned how to capitalize on their space as they continue to annex and continue to have more land to incorporate before running into Waukee to the west. From 2008-2012, the median household income was \$68,283. High school graduation rates for those 25 and older averaged 95.5%, and a bachelor's degree or higher for those 25 and older at 49.6% (US Census Bureau, 2014).

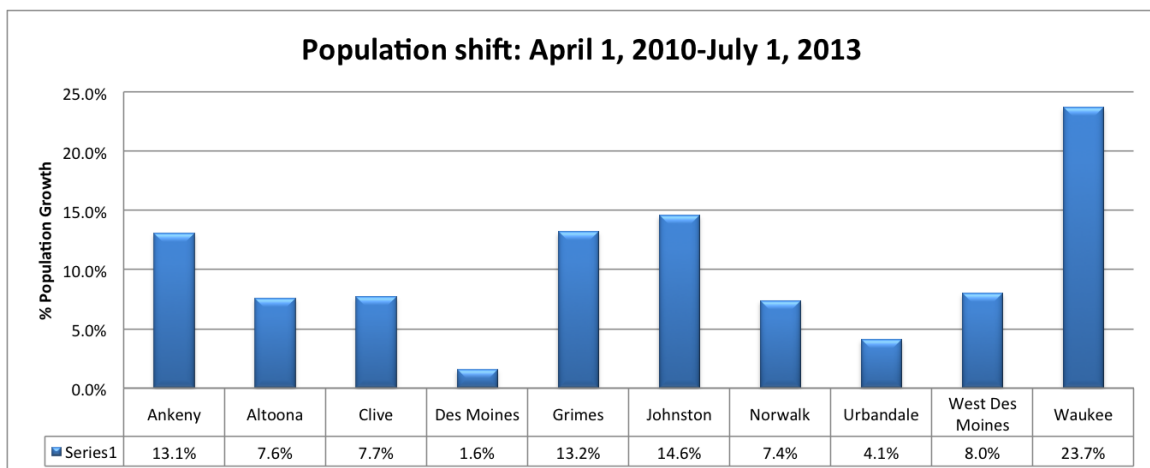


Figure 2. Population growth in Des Moines and nine suburbs from 2010 – 2013. The black line represents the state of Iowa population growth.

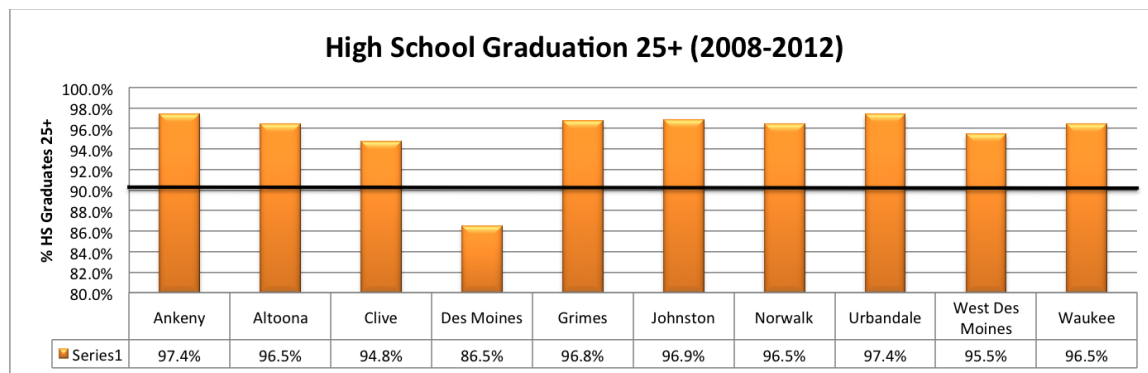


Figure 3. Graduation rates for Des Moines and the nine suburbs. The black line represents the average for the state of Iowa.

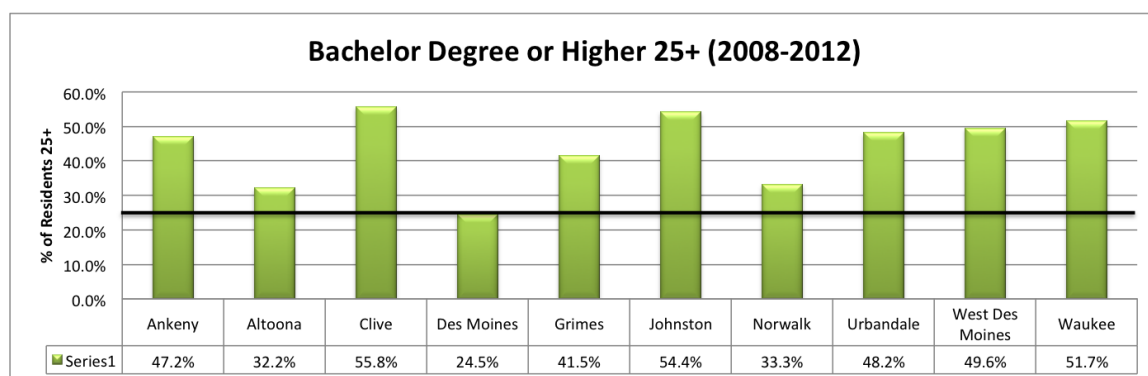


Figure 4. Rate of bachelor's degree or higher residents of Des Moines and nine suburbs. The black line represents the average for the state of Iowa.

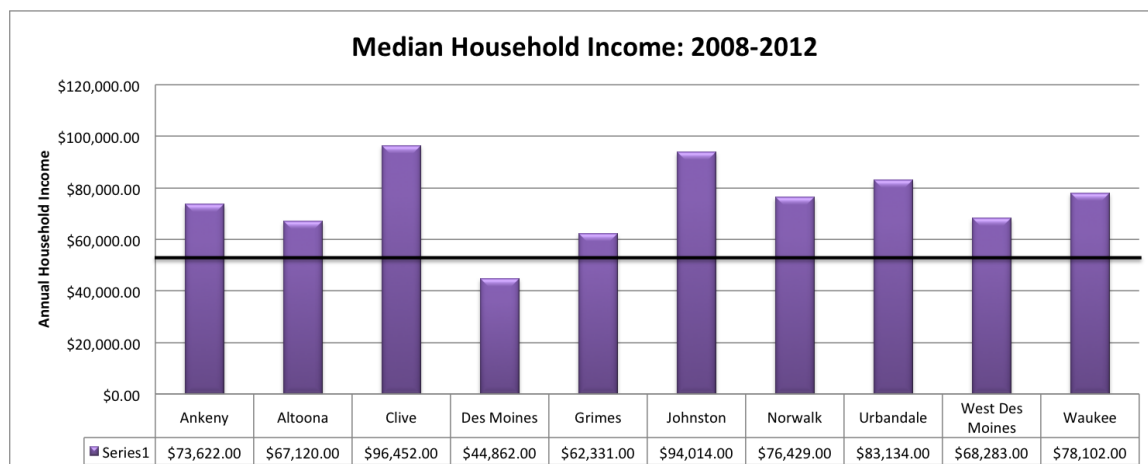


Figure 5. Median household income of Des Moines and the nine suburbs. The black line represents the median for the state of Iowa.

With nine major suburbs, the Des Moines metro may seem small compared to other larger cities, but all of the suburbs have grown over the past three years. Des Moines

has a lot to offer with jobs and housing, and many consider it to be an excellent area to raise a family. What might be one thing that keeps Des Moines and the suburbs divided? One answer to this is transportation. Having safe, reliable, affordable, and timely transportation is a must when getting from one suburb to downtown Des Moines. Each suburb may be less than a 20-mile distance from downtown, but if there is an accident or a weather-related issue, that 20 minutes could take a commuter an hour or more. Again, comparing that hour to other large metropolises some may say that hour is nothing. As for time commuting, wouldn't it be better spent in a more direct route? Would more citizens utilize public transportation if it were more direct? Could we build a bigger community with an approach to public transportation that is more conducive to commuting?

Current Transportation Systems

Des Moines Area Regional Transit Authority (DART)

DART busing has been a staple of the Des Moines area since its inception in 1973 as the Des Moines Metropolitan Transit Authority. DART originally started as a partnership between Clive, Des Moines, West Des Moines, Urbandale, and Windsor Heights. What began as a relatively small partnership has increased to a fleet of 90 buses and cars. With about 2,500 stops a day, DART has become an important part in getting people to work, home, schools, and much more (Hancock, 2006).

The DART buses use a basic hub-and-spoke system, which should make it more effective in efficiently traveling around Iowa. Although the system does work, there could be a multitude of improvements to increase utilization and efficiency. In

reality, their system appears to be a point-to-point system because of its ineffectiveness. There are some drawbacks to the point-to-point system; because the system is centralized, day-to-day operations can be relatively inflexible, and changes at the hub or in a single route could have effects throughout the network. The system can have problems, such as when there is high traffic through several areas, causing problems with the busing and scheduling. DART has also had difficulty providing accurate departure and arrival times, which adversely affects the people that use the system because they need a dependable, accurate transportation system. Aside from that, DART also needs better, less-polluting buses. Because of their age, most of the buses in DART's fleet aren't as green as newer buses would be, and they are causing a larger amount of pollution than newer buses would.

Over the next ten years (2015-2024), DART plans on making multiple changes to their system, both in infrastructure and technology. One example of a planned technological improvement is to provide real-time schedules and bus locations. The Capital Improvement Plan is designed to make problem-solving more efficient and effective. To do so, a three-tier program has been created.

- Tier one is the highest priority and must be dealt with funding from fiscal years 2015 and 2016; they are items that have a high-risk of failure, and the assets have passed their useful life.
- Tier two is a "medium" priority with funding from fiscal years 2017-2019. This deals with assets that are in working condition and will last another three to five years.

- Tier three is the lowest priority, with funding allocated between 2020-2024; these assets are nearing the end of useful life and must be replaced in six to ten years (Des Moines Area Regional Transit Authority, 2014).

The projects themselves are organized into six different categories: fleet/facilities, support equipment, technology, passenger amenities, development, and operations. Fleet and facilities deals with the actual buses themselves and the DART hub-and-spoke system. Support equipment is defined as the tools that help the system, including maintenance equipment. Passenger amenities include making things to assist the riders themselves, such as shelter, signage, and ease of access. Technology projects include updating servers to deliver on-time information. Development includes constructing one-time, large capital infrastructure projects, such as their recently-built, \$21 million DART Central Station. Lastly, the operations projects aim to increase the use of capital funds for allowable operating projects, including preventive maintenance, ADA Paratransit (Bus Plus), and transit planning (Des Moines Area Regional Transit Authority, 2014).

All of these improvements are aimed at making the bus system faster, more accurate, and more efficient while having less of an impact on the environment. In their long-term plan, DART outlines their plans for Bus Rapid Transit (BRT), and in addition to improving infrastructure and buses, they go on to explain that they will leverage their federal funding to keep the costs low for the consumer. DART explains how the customer will be having little if any increase in price with the changes they are making (Des Moines Area Regional Transit Authority, 2014).

Buses have the lowest average line capacity per hour, 3,800 to 7,200. A BRT can carry 9,000 to 30,000 passengers per hour (pph) and a Light Rail Train (LRT) can carry 12,200 to 26,900 pph. The highest potential line capacity is a Metro Rail Train (MRT) at 67,200 to 72,000 pph (Kille, 2009).

Implementing a railway system, whether it is a Light Rail Train or Metro Rail Train, could greatly benefit Des Moines and all the surrounding areas. Railways provide a cleaner and faster way to travel when looking at the problem economically and environmentally. The cost of this rail need not be mutually exclusive to the current busing system and its upcoming additions, but it can go hand-in-hand.

DART said that when they received the federal funding to create the BRT system, it could open the door for more funding for added infrastructure, which means that the funding could be used to create a high capacity MRT system that could effectively and efficiently travel to the greater Des Moines area and beyond.

Although it is more costly for the system to be put in place on average, bus rapid transit costs \$13.2 million per mile to build (BRT Chicago, 2014); light rail transit costs \$26.4 million per mile; and metro rail transit costs \$128.2 million per mile (Kille, 2009). While an MRT can be more expensive, it offers benefits in other ways, and they cost the least per thousand passenger miles. This means that MRT can provide the greatest transportation distance at the cheapest cost. There are drawbacks and benefits to different forms public transportation, but if LRT or MRT were to be implemented as well as the simple buses or the BRT, it could mitigate the issues Polk county and other residents face when using public transportation.

Taxicab Services

Taxicab services are available in Des Moines, IA and throughout the state. However, it is not a major mode of transportation. In fact, only two companies operate in the Des Moines area: Yellow Cab Company/Capitol Cab Company, and Freedom Taxicab. The primary benefit of taxicabs is prompt service anywhere, anytime. In fact, the average pick-up time of Yellow Cab/Capitol Cab within the Des Moines metro area was 12.8 minutes in 2010 (Trans Iowa, 2014). However, the primary drawback for the consumer is cost.

Alternatively, citizens often elect to use a privately-owned vehicle for most trips. While operating a privately-owned vehicle is very convenient, it is not without expense. When determining the operating expenses of a privately-owned vehicle, there are many factors to consider. However, the immediate costs (usually determined by cost of fuel/mile) pale in comparison to the aggregated costs of each mile. AAA (2014) stated “if you commute to work by car, figure about \$61 in total vehicles expenses per 100 miles” (p. 9). Consider the following route and fare in Figure 6.

Comparison between private vehicles and taxis

	Privately-Owned Vehicle	Freedom Taxicab	Yellow/Capitol Cab
Pick Up	North Ankeny	North Ankeny	North Ankeny
Drop Off	DSM International Airport	DSM International Airport	DSM International Airport
Distance	21 miles	21 miles	21 miles
Cost Estimate	\$11-16 + \$5-12/day parking	\$44-51	\$43

Figure 6. Taxicab fares retrieved from Freedom Taxicab and Yellow/Capitol Cab's websites; privately-owned vehicle cost determined using AAA's average cost per mile for a medium-size sedan (52.3-78 cents/mile). Factors in determining AAA's averages are: fuel, maintenance, tires, insurance, license, registration and taxes, depreciation, and finance costs (AAA, 2014).

Privately-Owned Vehicles (POVs)**Costs associated with vehicle accidents**

Although accidents are rarely framed around the notion of societal costs, society always bears a financial burden. Consider the following: more than 30,000 people are killed in crashes each year in the United States. Additionally, more than 2.5 million drivers and passengers were treated in emergency rooms in 2012, leading to medical and productivity losses exceeding \$80 billion (CDC, 2014).

In Polk County, IA, from 2007-2011, 5,260 crashes occurred resulting in 1,844 injuries, 52 fatalities, 169 major injuries, and 576 minor injuries (Iowa DOT, 2014). During the same period, Dallas County, IA experienced 2,117 crashes, resulting in

721 injuries, 21 fatalities, 100 major injuries, and 252 minor injuries (Iowa DOT, 2014). Reference Figure 7.

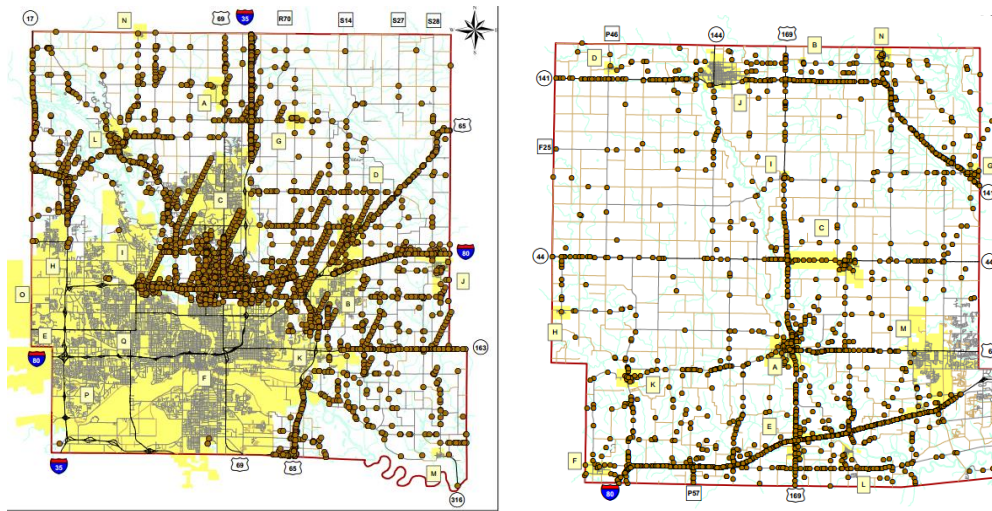


Figure 7. Reportable crash history for Polk County (left) and Dallas County (right) (Iowa DOT, 2014).

In 2013, Polk County had 312,258 licensed drivers; Dallas County had 52,942 (Iowa DOT, 2014). This means the total number of licensed drivers in 2/99 counties in Iowa was 365,200. Of these licensed drivers, 7,377 (2%) were involved in a motor vehicle crash. Two percent seems insignificant, but consider it in terms of dollars. If vehicle accidents were reduced by 2% in America, this would generate a savings of \$1.6 billion annually. If that money were somehow set aside and divided equally amongst all 50 states, \$32 million could be allocated towards the financing of various infrastructure and transportation projects, specifically public transportation. To put that number in perspective, DART has an FY 2015 budget of \$28.5 million (DART, 2014).

Public Transportation: a record of safety

Public transportation is a safe and reliable alternative to privately-owned/operated vehicles (POVs). In 2009, 33,808 people were killed in automobile accidents. Of those, only 26 (~.00077%) were bus passengers (DOT, 2014). Additionally, trips on public transportation result in 200,000 fewer deaths, injuries, and accidents than similar trips made by car (PA Commutes, 2014). To that point, the National Safety Council estimates that riding a bus is more than 170 times safer than traveling by automobile (PA Commutes, 2014).

In 2013, Iowa experienced 290 fatal crashes, resulting in 317 fatalities. Of the 317 fatalities, only 6 (usually involving a pedestrian) occurred as a result of a bus accident (Iowa DOT, 2014). For comparison, see Figure 8.

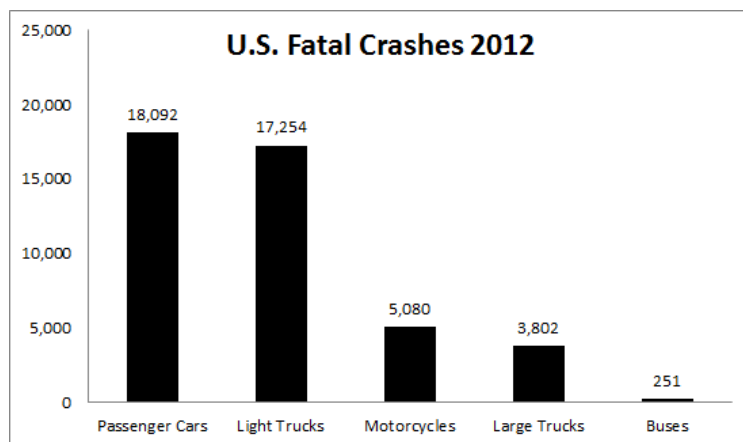


Figure 8. U.S. fatal crashes by vehicle type in 2012.

Advertisement: public versus private-sector

Although public transportation relies heavily on operation subsidies, an obvious disconnect occurs at the advertising level. In this section, advertisement expenditures for the private automotive and public transportation sectors will be compared.

The automotive industry is an economic giant. As of February 2014, Toyota is the world's most profitable car company with a net income of nearly \$20 billion from March 2013 - March of 2014 (McIntyre, 2014). A large part of that success hinges on successful advertisement. Advertisement and sales promotions are intended to reach the masses and, most importantly, influence their purchase decision(s).

Toyota, for example, spent \$3.7 billion in 2013 on advertising and sales promotions, or about 18.5% of their net income (Toyota Motor Company, 2013). By comparison, the DART plans to spend \$275,000 of its FY15 \$28.5 million budget on advertising, just under 1% (DART, 2014).

While public transportation was never designed to compete head-to-head with the automotive industry, a serious advertising deficit continues to occur, and that translates into more privately-owned/operated vehicles (POVs) and fewer riders of public transportation. In 2013, Polk County, IA had 216,429 registered automobiles, 19,481 motorcycles, and 67,545 trucks; Dallas County had 31,828 registered automobiles, 3,250 motorcycles, and 11,695 trucks. When the most common POVs are summed, 350,228 vehicles were on the road at any given time (Iowa DOT, 2013). By contrast, DART operates 90 buses in a metro with 569,633 residents (as

of 2010 census) (DART, 2014). This means there are .61 POVs per person in the Des Moines metro. Conversely, there are .000016 buses per person in the same area. Another way of understanding the disproportion: there are 3,891 times as many POVs as buses in the Des Moines metro (Figure 9).

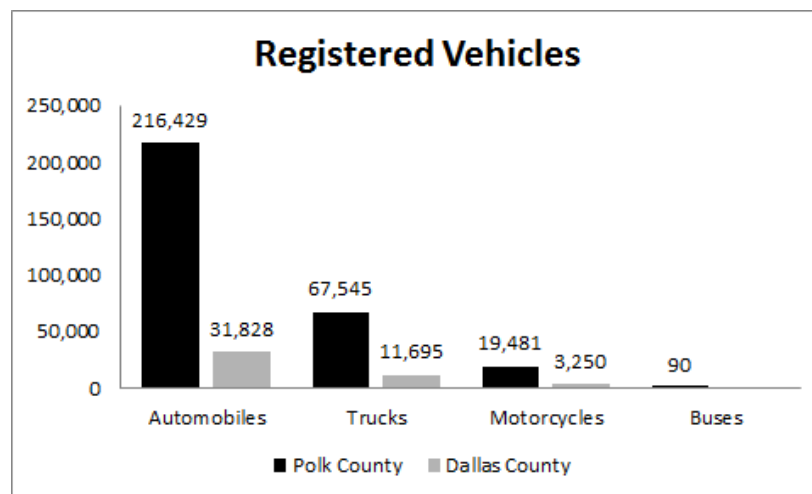


Figure 9. Number of registered vehicles in Polk and Dallas County compared to number of DART operated buses.

Pollution

Automobile emissions contribute to smog, climate change, and public health problems. To that point, cars account for about 50% of air pollution nationwide. However, alternatives exist. For example, buses emit 80% less carbon monoxide than single-passenger automobiles; rail emits almost none (PA Commutes, 2014). Carbon monoxide is a greenhouse gas. Greenhouse gasses act as an insulator by trapping heat that would otherwise escape into space, thus contributing to climate change (NCDC, 2014).

Air pollution also affects the health of individuals. The Environmental Protection Agency (EPA) states that exposure to ground-level ozone (smog) for 6-7 hours per day “significantly reduces lung function and induces respiratory inflammation in normal, healthy people during periods of moderate exercise” (EPA, 2014).

The dirtiest and cleanest cities have been identified (Figure 10) by the American Lung Association (ALA, 2014).

Dirtiest Cities	Cleanest Cities
Los Angeles, CA	Anchorage, AK
Visalia-Porterville-Hanford, CA	Bangor, ME
Bakersfield, CA	Bellingham, WA
Fresno-Madera, CA	Bend-Redmond-Pineville, OR
Sacramento-Roseville, CA	Bismark, ND
Houston, TX	Brownsville-Harlingen-Raymondville, TX
Modesto-Merced, CA	Brunswick, GA
Washington-Baltimore-Arlington, DC-MD-VA-WV-PA	Burlington-South Burlington, VT
Dallas-Fort Worth, TX-OK	Cape Coral-Fort Meyers-Naples, FL
Las Vegas-Henderson, NV-AZ	Charleston-North Charleston, SC
	<i>Des Moines-Ames-West Des Moines, IA</i>

Figure 10. Dirtiest and cleanest cities as determined by ozone air pollution. Retrieved from the American Lung Association.

Comparable Cities

Examining the differences in the policy and the development of communal facilities between high-growth and low-growth areas can provide evidence that may help stagnant or declining cities reverse their fortunes. Austin, Texas; Minneapolis, Minnesota; and Lincoln, Nebraska are three Midwestern cities with public transportation systems. Based on the similar geographic location and Midwest cultural background, Des Moines is roughly comparable to these urban areas in aspects such as population density and income tax.

	DSM, IA	Austin, TX	Minneapolis, MN	Lincoln, NE
Population 2013	207,510	885,400	400,070	268,738
Land area in square miles 2010	80.87	297.90	53.97	89.11
Population Density 2010	2,515.60	2,653.20	7,088.30	2,899.40
Per Capita Income 2008-2012	23,914	31,387	30,734	26,149
Income Tax	7.93%	0.00%	7.05%	5.01%
Persons below poverty level 2008-2014	17.70%	19.40%	22.50%	15.50%

Figure 11. Demographic comparison of Des Moines, Austin, Minneapolis, and Lincoln.

Fifty years ago, the population levels of Austin, Des Moines, and Lincoln were very similar (see Figure 12). By 2013, Austin's population had increased by almost 1 million, while Des Moines's population had remained the same. Minneapolis had a

larger population in 1960, but decreased in 1960-1980 and stayed almost the same level from 1980 to 2013.

Although the population and land area disparity between Austin and Des Moines are huge, their population densities are similar. The disparity also exists in the areas of real personal income, tax burden, and the number of persons below poverty level.

Although there are numerous factors that can influence the growth of population and economies, one finds the public transportation system a considerable factor.

Population Growth 1960 - 2013

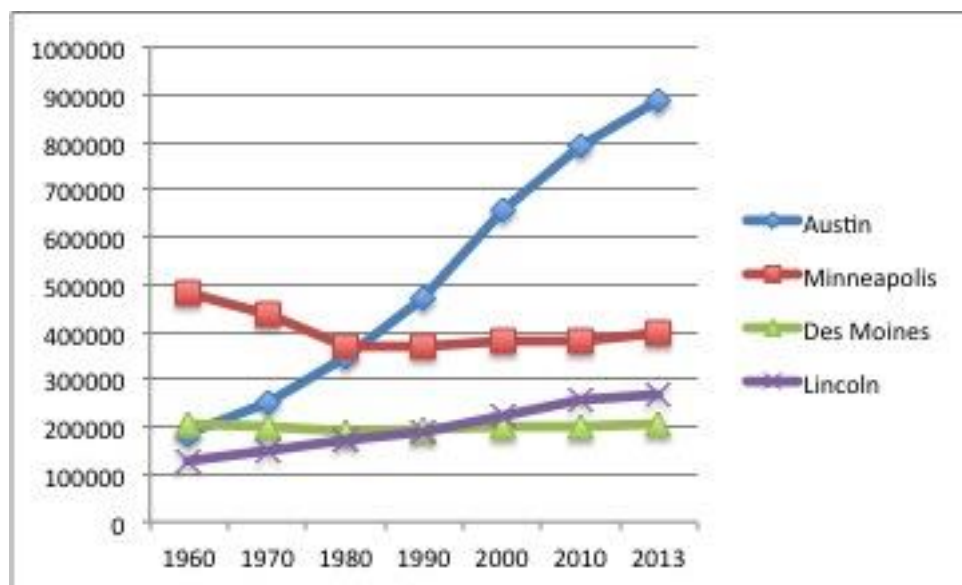


Figure 12. A comparison of population growth 1960-2013 in Austin, Minneapolis, Des Moines, and Lincoln.

Overview of the Public Transportation Systems of four cities

	DSM, IA	Austin, TX	Minneapolis,MN	Lincoln, NE
Bus	Yes	Yes	Yes	Yes
Rapid Bus	No	Yes	Yes	No

Light Rail	No	Yes	Yes	No
Metro	No	No	Yes	No
University shuttle system or intercampus bus routes	No	Yes	Yes	Yes

Figure 13. Comparison of the features of the public transportation system in each of the four cities.

Considered a global city, Minneapolis has the most complete urban transportation facilities including bus, rapid bus, light rail, metro, and intercampus shuttle systems. With the largest population of the four cities, Austin's public transportation system supports the need of the growing population. Lincoln is the most comparable in these indices to Des Moines, but it has more robust special bus routes and programs.

Austin, TX

Capital Metropolitan Transportation Authority (Capital Metro)

Since 1985, Capital Metro is Austin's regional public transportation provider. With 50 Metro routes, two MetroRapid routes, eight Express routes and 19 UPT shuttle routes and 3,000 bus stops throughout Central Texas, Capital Metro has over 32 million boardings every year (Capital Metropolitan Transportation Authority, 2010).

Components of Capital Metro:

- *Capital MetroBus* - 49 metro routes and 8 Express routes include Local Service, Flyer and Limited, Feeder, Crosstown, Special Services, Express, and University of Texas Shuttles.
- *MetroRapid Routes* - Metro launched an express bus service branded "MetroRapid" in January 2014. The MetroRapid routes ("Rapid Bus") is a

special rapid bus line serving high-traffic corridors at the frequencies of 15 minutes on weekdays (KUT News, 2014). By sharing lanes with common automobiles, articulated rapid buses started service on January 26, 2014 (Michael, 2014).

- *Feeder Routes* - A kind of traffic service based on location. With a form of “a major transfer point”, the Feeder Routes help connecting local neighborhood.
- *Crosstown Routes* - A location-based route that services between two neighborhoods of Austin. It does not pass through the University of Texas nor the downtown area of Austin.
- *Express Routes* - Limited stop services that run between Downtown Austin and the far suburbs.
- *University of Texas Shuttle System* - As the largest university transit system of the country, the UT Shuttle system has 14 routes, 87 buses, and carries about 7.5 million passengers each year (Shuttles, 2011). The University of Texas contracted out its campus shuttle service to Capital Metro in 1988. Since September 19, 2002, Capital Metro has operated routes called “E-bus” which stands for “eating and entertainment.” The routes are used to ferry students between the residential areas with heavy population. The funding of “E-bus” was initially provided from companies advertising on the bus (Capital Metropolitan Transportation Authority, 2014).

The “Growing Pain” of the Capital Metro

Capital Metro was created in January 1985. Approved by voters, a one percent sales tax was used to fund the source of the organization. The sales and use tax was lowered to 0.75 percent by the board of directors in December 1988 but was reinstated to the full one percent in 1995 for funding the new light rail system (Capital Metropolitan Transportation Authority, 2011).

After raising its sales tax from 0.75 percent to 1 percent in 1995, Capital Metro had stockpiled \$176 million by the 2000 referendum. In 2000, the light rail was defeated at the polls, and the quarter-cent tax was set aside for the rail projects. Mass pressure was mounted on Capital Metro. Including former Republican state Rep. Terry Keel of Austin, Travis County Commissioner Gerald Daugherty, and his anti-rail group Reclaim Our Allocated Dollars (ROAD), political leaders and organizations tried to push the sales-tax money change on building projects such as a highway loop around Austin and an east-west freeway. Keel had intended to change Capital Metro's taxing authority back to a half-cent and reallocating the other half-cent to construction of highway (Gregor, 2010).

In order to keep the prospects of rail's future alive, the Capital Metro board made two promises in the months after the vote: the \$91 million of the existing reserves of the firm would be directed to local governments for transportation projects. Also, a quarter-cent of its tax that year would be dispensed to those same governments above. The "quarter-cent promise" was extended, eventually amounting to \$113 million for three more years. The city of Austin received 97% of Capital Metro sales taxes as the main beneficiary of the promises. At least \$106 million of the total \$204 million was promised to Austin and smaller cities since 2000 (Wear, 2010). More than \$300 million was spent on a new maintenance and operations center, commuter rail, park-and-ride lots, and other facilities at the same time. The organization implemented a hiring freeze except for critical positions in October 2008. While more than 70 percent of its revenue comes from local sales taxes, Capital Metro faced a revenue shortfall of approximately \$22 million in 2009 when

the Great Recession spread to the city. Tax revenues of Austin dried up, and Capital Metro was forced to stop payment on \$51 million that it owed to the city of Austin (Gregor, 2010).

The development of MetroRail

After four years of extra lobbying, Capital Metro won the opportunity to build a commuter rail on existing freight rail lines in 2004. In September 2005, Capital Metro awarded a contract to build six diesel-electric rail cars. Each has a capacity of up to 230 passengers. Continued construction problems and safety issues caused the project to exceed budget over the initial cost at \$90 million. After the delay, the construction continued and the Capital MetroRail finally opened on March 22, 2010 (Wear, 2008).

Compare with DSM

As the third-fastest-growing large city in the nation from 2000 to 2006, Austin has a much larger population than Des Moines (Christie, 2007). While the two cities had same population in 1960, Austin grew throughout the 20th century. The city has become a center for government and education with the Texas State Capitol and the University of Texas at Austin. After the Great Depression, Austin resumed its development into a major city and, by the 1980s, it emerged as a center for technology and business. What's more, as the flagship of several well-known companies such as Apple, IBM, ebay, Google and Intel, Austin's urban transportation system must support the growth and development of various businesses. It also

created an environment of efficiency, rapid pace, and easy travel, which is attractive to young people and new businesses.

As a major center of the national insurance industry, many insurance companies are headquartered in Des Moines, including Principal Financial Group, Wellmark Blue Cross and Blue Shield of Iowa, and Holmes Murphy. Wells Fargo and Voya Financial made Des Moines a power in financial services, and Meredith Corporation is also based in this city. If Des Moines can develop a better urban transportation system, the city can attract more young people and active business firms.

Minneapolis, MN

Metro Transit is the primary public transportation operator of the twin cities. It offers an integrated network of buses, light rail and commuter trains (Metro Transit, 2014).

The main components of Metro Transit include:

- METRO – Metro is a public ground transportation that serves the Minneapolis-St. Paul metropolitan area in Minnesota. It includes transit buses, intercity bus lines, light rail, and the commuter and intercity rail. The system is a part of the region's metropolitan planning organization (MPO), the Metropolitan Council. Each weekday, the system carries 90% to 95% of the transit riders in the region at about 267,700 riders, on a combined network of regular-route buses and rails (Metro Transit, 2014).

METRO has three lines that are named by colors:

- The light rail Blue line travels between Target Field and Mall of America.
- The Green Line started serving in June 2014. It goes through downtown Minneapolis and downtown St. Paul.
- The Red Line travels on Cedar Avenue and also providing Bus Rapid Transit (BRT) between Apple Valley and Mall of America (Metro Transit, 2014).
- The University of Minnesota's Campus Shuttle system- The University of Minnesota's Campus Shuttle system is a zero-fare bus service, operating on the university's campuses all over Minneapolis and St. Paul. The system carried more than 3.9 million riders in 2009, making it the second-busiest transit system in Minnesota after the Twin Cities' primary provider, Metro Transit (Eggert, 2010).

The Development of Metro Transit

The Metropolitan Council initiated the creation of a mass transit for the twin cities metro area in the 1970s. The construction was roughly contemporaneous with the construction of Washington D.C.'s Metro system and San Francisco's Bay Area Rapid Transit. But unfortunately, due to the opposition from the Minnesota legislature, the idea was eventually abandoned. But today, Minneapolis has two light rail lines and one commuter rail line and has recently increased to three lines (Blue, Green, and Red) in 2014 which connects Downtown Minneapolis, St. Paul, and Bloomington as well as the Minneapolis-St. Paul International Airport. The Blue and Green Lines are

operated by Metro Transit, and by the Red Line is operated by the Minnesota Valley Transit Authority (Office of the Legislative Auditor State of Minnesota, 2002).

Comparison with Des Moines

Minneapolis is the largest city in the state of Minnesota, and though it covers a smaller land area, its population is almost twice the population of Des Moines. Under the great pressure of high population density, a well-operated urban transportation system became the backbone of the city. Minneapolis has become the main business center between Chicago and Seattle today, containing America's fifth-highest concentration of Fortune 500 companies (Encyclopaedia Britannica, 2014). Compared with Minneapolis, Des Moines has less population pressure and more land resources. To leverage this growth potential, Des Moines needs the support of a better urban transportation system.

Lincoln, NE

The city has a public bus transit system called StarTran that consists of 62 full-sized buses and 13 Handi-Vans (StarTran, 2014).

Development of StarTran

In order to more effectively increase the visibility of StarTran services, several promotional programs and "special services" of the StarTran's service were expanded in 1995. Such programs extended the program to different groups of people: the Employee Bus Pass Program, the Low Income Bus Pass Program, and the Passport Saver (discontinued in October 2012). Other programs are available for special time periods, including the Holiday Light Tours and the StarPass (summer

youth bus pass). There are also programs for tours: Smart Commute, Historical Tours, Big Red Express, Boo at the Zoo, Stuff the Bus, "Get on Board" senior days, and special event and concert shuttles (StarTran, 2014).

Since 2011, the Lincoln Metropolitan Organization (MPO) started a Long Range Transportation Plan (LRTP) called LPlan 2040, which provides the blueprint for the area's plan of transportation over the next 30 years. It considers a full complement of transportation components, including trails, pedestrian and bicycle facilities, transit, roads, railroads, airports, and airfields. LPlan 2040 proposes a new way of looking at growth and land use in the city and county. A new emphasis on mixed use redevelopment and infill within the existing city will serve to increase the overall density of the city, concentrating it in areas along major transportation and utility corridors (Lincoln Metropolitan Planning Organization, 2011).

Comparison with Des Moines

With a similar level of population to Des Moines, Lincoln has a fairly typical economy of a mid-sized American city; service industries account for most economic activity. Besides the large contributions to the local economy, the city's government and the University of Nebraska-Lincoln, other prominent industries include finance, insurance, publishing, manufacturing, pharmaceutical, telecommunications, railroads, medical, information technology, education, and truck transport (Nebraska Department of Labor, 2014). The city's indexes of population, density, land area, personal income, and tax rate are quite similar to the city of Des Moines.

Lincoln has several special shuttle lines for sports events and college intercampus connections, as well as Employee Pass program and Low Income Pass program. Those special routes and programs promote the ridership of the public transportation system and attract more people to use the public service instead of driving themselves. Looking at the situation in Des Moines, some companies do have cooperation with DART's system and encourage their employees to take buses. But the lack of efficiency of the bus system and fewer urban transportation options are unlikely to help reduce the parking and traffic pressure of the downtown area. There are no special routes to connect the different campuses of DMACC, DMU, Grand View University, or Drake University.

Transportation Models

Hub-and-Spoke vs. Point-to-Point

There are two conceptual models for mass-transportation: point-to-point and hub-and-spoke. The aviation industry is a transportation giant that primarily utilizes a hub-and-spoke model. However, this was not always the case. Prior to the Airline Deregulation Act of 1978, an airline's operating certificate, routes, schedules, and ticket prices were dictated by the Federal Civil Aeronautics Board (CAB) (Cook & Goodwin, 2008). The regulation prior to 1978 posed many barriers to entry, and because of this, many startup airlines went bankrupt trying to compete with "the big four" airlines of the 20th Century: American, Eastern, TWA, and United (U.S. Centennial of Flight Commission, 2014). Of the big four, only two remain: American and United; other legacy airlines have been absorbed through mergers or lost

altogether. Today, the big four—as determined by the number of passengers emplaned (Figure 14)—are:

- 1) American
- 2) Delta
- 3) United
- 4) Southwest

Ironically, only Southwest Airlines has maintained profitability (41 consecutive years) and never declared bankruptcy in the past; the same cannot be said of the other “big” airlines (CNN, 2013).

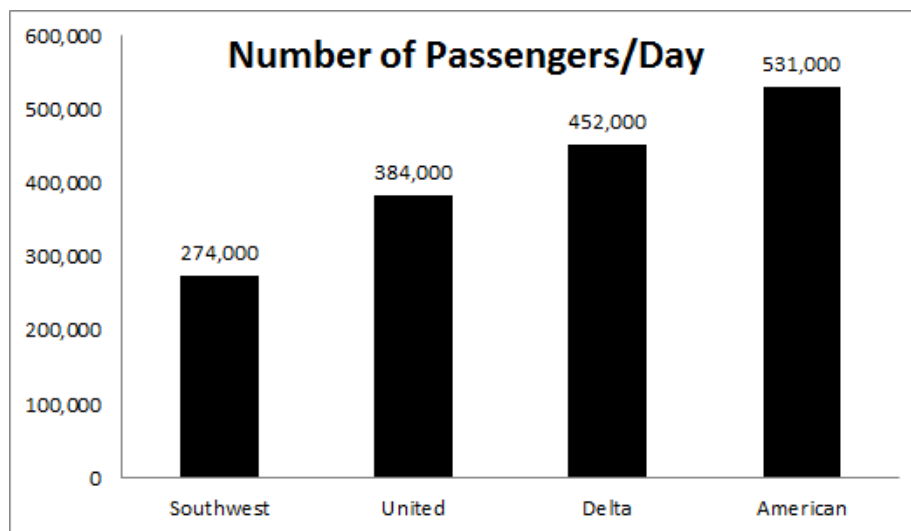


Figure 14. Number of passengers served daily. Stats retrieved from individual airlines’ websites. Some values were converted from annual to daily for table continuity.

Originally, airlines flew point-to-point. This meant each airline flew specific origin/destination routes (Sandaruwan, 2010). For example, Southwest Airlines began service offering only three point-to-point routes, all in Texas (figure 15): Dallas, Houston, and San Antonio (Schangenstein, 2014). Today, Southwest Airlines continues to operate under a point-to-point model while other airlines have

embraced the hub-and-spoke model. While many drawbacks exist in a point-to-point model, the most significant drawback is a lack of ridership among customers located outside of the service area. Living outside of the service area requires additional investments of both time and money, thus, discouraging or eliminating potential passengers from air travel.



Figure 15. Initial routes offered by Southwest Airlines.

By contrast, the hub-and-spoke model (figure 16), pioneered by Delta Airlines in 1955, was designed to bring the greatest number of passengers to a central location (the hub) and connect them to individual nodes (the spokes) (Delta, 2014). Today, Delta Airlines continues to operate under a hub-and-spoke model with eight domestic hubs: Atlanta, GA, Boston, MA, Detroit, MI, Los Angeles, CA, Minneapolis, MN, New York, NY, Salt Lake City, UT, and Seattle, WA (Delta, 2014).

In Des Moines, IA, several point-to-point routes are flown to Las Vegas, NV, Los Angeles, CA, Fort Myers, Orlando, and Tampa Bay, FL, to name a few. However,

passengers wishing to travel to a destination not covered under the point-to-point model must first connect to a major hub. Des Moines International Airport would not be considered a hub; it would be considered a spoke serving only 2.2 million passengers annually (Aschbrenner, 2014). By contrast, Chicago's O'Hare international Airport would be considered the Midwest's hub, serving over 67 million passengers annually (Perkins, 2014). Not only is Chicago's O'Hare International Airport the second-busiest airport in America (behind Atlanta's Hartsfield-Jackson International Airport), it ranks 5th in the world (Perkins, 2014).

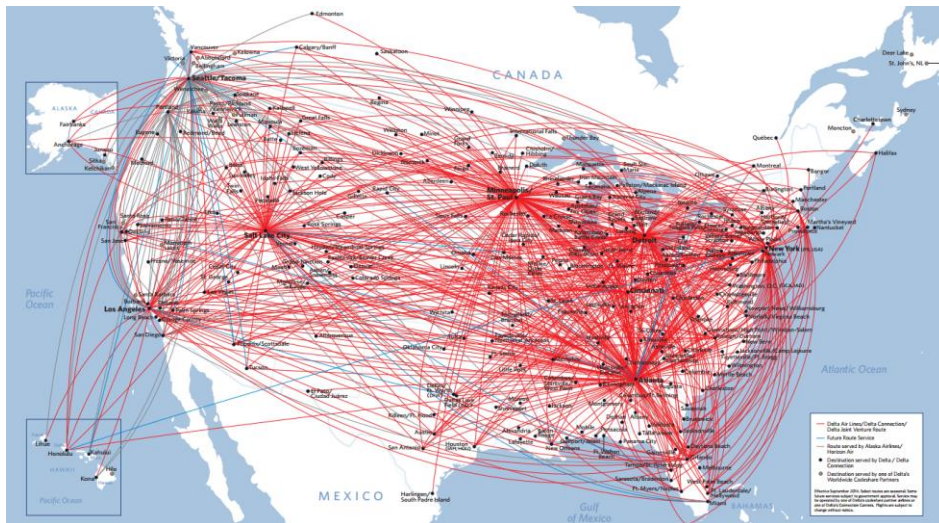


Figure 16. Delta Airlines Hub-and-Spoke. Delta Airlines domestic hubs: Boston, MA, Cincinnati, OH, Detroit, MI, Atlanta, GA, New York, NY, Los Angeles, CA, Minneapolis, MN, Salt Lake City, UT, and Seattle, WA.

Current Uses of the Hub-and-Spoke

Due to the success—and simplified nature—of the hub-and-spoke model, many industries have adopted the model to suit different needs. For example, telecommunications utilize different network segments, much like those found in the transportation industry (Lei, 2013). Even education has embraced the hub-and-

spoke model. Numerous institutions ranging from private to public, profit to non-profit, have taken on the role of a major hub serving students at various nodes, either in-person or online. A traditional online school, such as the University of Phoenix, serves as both an educational and telecommunications hub due to the method of instruction. In addition to online connectivity, numerous satellite locations exist throughout America (and Puerto Rico), acting as spokes to the primary hub (University of Phoenix, 2014).

DART and the Hub-and-Spoke

While the hub-and-spoke model is incredibly efficient and capable of serving the masses, it still relies on supplementation, often through use of a point-to-point model. In central Iowa, the problem is reversed: Central Iowa's public transportation system primarily utilizes a point-to-point model, although DART suggests its model is a hub-and-spoke. While the point-to-point model works, it is inefficient and neglects to connect passengers from the spoke(s) to the hub: Des Moines, IA. However, the point-to-point model is quite versed in connecting downtown and surrounding areas of Des Moines, IA (reference figures 17 and 18 below). DART operates 90 buses that travel over 15,000 miles per day. Additionally, DART services include: Local Routes, Express Routes, Flex Routes, On Call, Shuttles, School Routes, Paratransit, and RideShare (DART, 2014).



Figure 17. Route 42 – D-Line Downtown Shuttle. Operates weekdays every 10 minutes from 6:30 a.m. to 6 p.m. through the East Village and the Western Gateway along Grand Avenue and Locust Street.



Figure 18. Route 40 – The LINK Shuttle. Operates weekdays every 15 minutes from 5:30 a.m. to 6:30 p.m. Operates from Center Street Park & Ride and along 7th and 8th Street.

Transit Funding

As with many state transit programs, funding can become a major issue in expanding service and attempting to modernize fleets and transit options. Iowa is no exception to this funding crisis, as more and more commuters are turning to private transportation rather than mass transit. This is not to say that Iowa's transit system is not being used, providing over 130 million rides to Iowans across the state over the last five years (Iowa Public Transit System, 2014).

As we analyze the hypothesis of this research, it is nearly impossible to not acknowledge that this severe lack of funding is causing multiple problems in Iowa's transit systems. Not only are municipal funds lacking for road and highway repairs, but the buses and transport vehicles themselves are nearly deteriorating due to the decrease in both state and federal funding over the last few years.

According to Mark Little, President of the Iowa Public Transit Association (IPTA), 56% of the 1,610 transit buses in service surpass the Federal Transit Administrations (FTA) standards for useful life. An analysis done by the state determined that nearly \$120 million would be needed only to replace these buses that have been deemed inadequate.

With Iowa receiving less than \$60 million in federal funds for transit projects and \$15 million for operational costs, it is clear that sourcing this \$120 million will not be simple. Transit officials have requested \$5 million in funds from the Iowa legislature to replace the oldest vehicles first; this is seemingly just a drop in the bucket for the amount which will be needed to replace and maintain the existing bus system through 2018, estimated at \$180 million. State funding has been varying between \$9-11 million per year over the last five years (Iowa DOT, 2014).

Focusing on the federal side, much of the funding crisis is a direct result of the signing of MAP-21 by President Obama in the summer of 2012. This legislation decreased crucial federal funding by 57%, and most of this funding was designated for bus systems and facilities (Dewitt 2014). This bill originated in the senate banking committee and was heavily influenced by more urban populations, where

transit is mainly conducted by rail. In fact, rail programs have been getting more than 90% of the capital funds designated to transit. As Ed Redfern, an IPTA lobbyist, states, “We carry 54 to 56 percent of all the transit passengers and get less than 9 percent of all the capital funds, and the rail programs are getting over 90 percent of the funds.” This disparity in funding is seemingly being overlooked by legislators and politicians but is being heavily felt by the transit systems across Iowa and within urban Des Moines.

MAP-21

On July 6, 2012 the Moving Ahead for Progress in the 21st Century bill was signed and became law. MAP-21 is based on program restructuring in three major areas, Federal Highway Aid, Highway Safety programs, and Transit programs. The main objective of this law is to consolidate federally-funded programs and to restructure existing programs. As seen in the table below, transit programs have been slated to see a significant decrease in federal funds, beginning with a large cut in 2015 followed by slow reestablishment, but never meeting funding amounts from 2010-2014 (Iowa DOT, 2014).

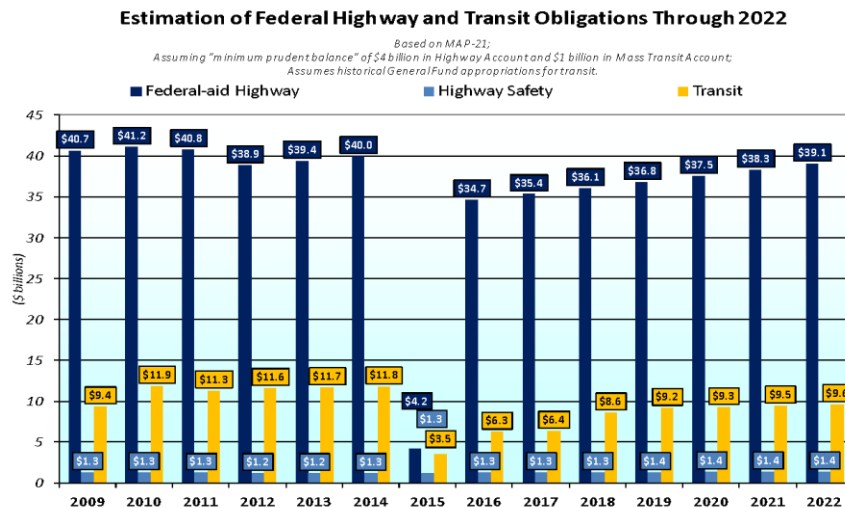


Figure 19. Estimation of Federal Highway and Transit Obligations Through 2022. (Iowa DOT, 2014)

MN Blue Line

Formerly known as the Hiawatha line from 2004-2013, the Minneapolis “Blue-Line” LRT system connects three of the major attractions near the twin cities: downtown, Minneapolis/St. Paul International airport, and the Mall of America. Federal, state, and local resources funded the transit system, which is a 12-mile, 19-station rail line.

According to Metro Transit, the funding sources are as follows:

Construction funding (in millions \$)

Funding Source	Funding (millions \$)
Federal Government	334.3
State of Minnesota	100
Metropolitan Airports Commission	87

Hennepin County	84.2
Congestion Mitigation/Air Quality grant	49.8
Transit capital grant	39.9
Minnesota Dept of Transportation	20.1
Total	715.3

Figure 20. Sources of funding for the Minneapolis Blue Line.

The funding sources, as provided by the Metro Transit authority of Minnesota, show that not only does interest in mass transit systems come from the state and federal level, but also from individual counties. Moreover, individual counties can be epicenters of funding efforts. Hennepin County, as an example, provided nearly 12% of total funding needed for the initial Blue-Line. Furthermore, grant funding for projects similar to the Blue-Line is still available, and not only come from transit grant funds but also from air quality and general traffic mitigation. This is important, as federal funding has been slated to decrease over the next few years, in part due to laws such as MAP-21.

Therefore, these funds will have to be sourced from grants, counties, and other sources, if Des Moines were to see something similar to the Blue Line. Delving further into the financials of Minnesota's Blue Line, 24 light rail transit (LRT) cars were purchased in 2001 at a cost of \$2.8 million each. New orders that have been

placed since then, and the most recent from 2014, see the cost rise to \$3.35 million each (Metro Transit, 2014). This increase in price is due to inflation, more advanced technology within the cars, and higher regulatory standards. However, these cars have a life expectancy of 30-50 years depending on upkeep.

We have compared the sizes, demographics, and ridership of Minneapolis/St. Paul and Des Moines. It can be said that these cities have similar needs when it comes to transit; the Twin cities have been able to supplement this need with a LRT system that has been heavily used and praised. We believe that Des Moines could benefit from a similar system, scaled to size. The financial landscape has proved that what little federal funding there is to come will be prioritized to rail funding. Also with numerous surrounding cities/counties, Des Moines could look into other sources for funding the way Minneapolis did with Hennepin County.

Feasibility of Transportation Systems

Light Rail

In 2000 a feasibility analysis was done by the Des Moines Area Metropolitan Planning Organization (DMAMPO) to determine if a light rail system would be appropriate for Des Moines. After examining the financials, they concluded that the system would operate at nearly a \$7 million dollar deficit each year, bringing in only \$500,000 in revenues. It has been noted that nearly all existing LRT mass transit systems run at a deficit, with the rest of the cost being subsidized. It was established by this analysis that it would cost \$22 per ride per traveler, with \$2 of cost covered by the fare, and the rest being subsidized. The researchers of this analysis concluded

that Des Moines was able to sustain such as system in the infrastructural and geographical senses, but that pure ridership, usage, and interest would be nearly insurmountable obstacles.

Now, nearly 15 years later, with many of the city's constituents leaving downtown urban Des Moines in favor of more suburban cities such as Urbandale, Clive, and Waukee, along with a growing young adult population who have been known to flock to light rail transit, a LRT system could be just the right fix to Des Moines's disconnection problems.

These calculations reveal the required number of train-sets, and their approximate cost, based upon the scenario:

Cost of Light Rail Train

Headways	Number of Train-sets	Cost (\$ million)
60 minutes	3	\$7.5
45 minutes	5	12.5
30 minutes	6	15.0
15 minutes	11	27.0

Figure 21. Costs of light rail train (LRT) versus turnaround time (headways). Source: Des Moines Area Metropolitan Planning Organization.

Streetcar

In 2008 a feasibility analysis was done on the city of Des Moines and its possible ability to sustain a streetcar system (Conaway, 2008). Streetcars are integrated into existing infrastructure and can be a very efficient method of transit in a downtown-like area. The analysis was very positive, as a streetcar system could effectively service much of the downtown population and provide a new transit option to various downtown attractions, businesses, and hospitals. The researchers examined the roadways of Des Moines and determined a streetcar circulator system would be feasible in terms of costs and existing infrastructure (Conaway 2008). With an estimated cost of \$80 million, much of the funding for the streetcar system would come in the form of grants from the Transportation and Infrastructure Finance and Innovation Act, and from other “small starts” grants that fund projects of the size and spectrum such as this. Finally the last third or so of the funding would have to come from local sources and interests (Conaway, 2008).

However, as the analysis has shown, if the streetcar system could revitalize and reinvigorate the downtown area and provide more consumers with an easy and efficient transportation method to all their favorite attractions, this could be attractive for many investors. This feasibility analysis shows just another option of connecting Des Moines and its surrounding cities and allowing for easier transit between the existing infrastructures.

High Occupancy Vehicle (HOV) Lanes

HOV lanes have been utilized since the late 1960s. Initially labeled as “bus-only” lanes, these lanes have now transitioned into carpooling lanes. HOV laws differ from state to state, but generally the lane is reserved for vehicles with 2 or more passengers. Certain states, such as Virginia, have 3- or more-person lane designations. HOV lanes can be in effect for only a certain time period, such as from 6 to 8am, or 24 hours a day (Virginia DOT, 2014). The lanes are marked with a diamond insignia in the middle of the road and usually two double white lines separating it from adjoining non-HOV lanes. In California, misusing an HOV lane can result in a \$400+ fine; in Virginia, misuse can result in a \$100 fine and a point on your license (Virginia/California DOT, 2014). These lanes are not only cost-efficient, as there is only the initial investment, but also generate revenue from ticketing. The exceptions may also allow for emergency response vehicles, single-ride motorcyclists, and for “clean fuel” burning cars with a state designation to use the HOV lanes as appropriate. Overall, these lanes provide a congestion-reducing effect and can promote the use of carpooling and ride-sharing. Des Moines has not implemented the use of HOV lanes; however, this would be an easy and cost-efficient method of decongesting interstates and roadways to better ease transit in and out of the city.

Attitudes about public transportation

The authors conducted a survey of Des Moines-area residents from November 4 - 15, 2014. This survey was conducted online via [surveymonkey.com](https://www.surveymonkey.com), and 102

respondents were recruited via social media channels. While the survey is by no means representative of the population of the Des Moines metro, the results revealed some interesting attitudes about public transportation among Des Moines area residents.

Q4 What is your biggest barrier to going to downtown Des Moines more frequently?

Answered: 100 Skipped: 2

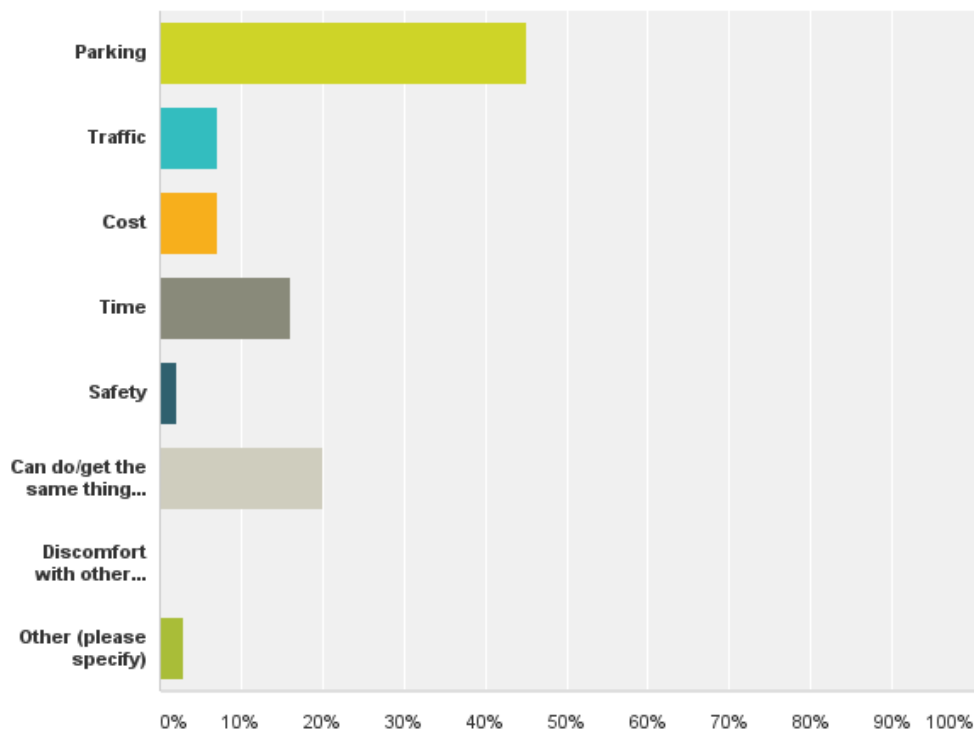


Figure 21. The 102-person survey revealed that parking was the greatest barrier to going downtown, followed by the reason that one can do or get the same thing closer to home.

The results showed that while parking was the reason most often cited as the barrier that kept respondents from going downtown more often, the second reason was that they could do or get the same thing in their own suburb. This supports the idea that the suburbs are disconnected from the urban core. When the downtown

fails to offer a compelling reason to overcome the perceived parking barrier, something significant must be done to keep the downtown area vibrant.

While a viable public transportation system would not initially or independently be able to overcome the fact that people feel they can more conveniently stay within their suburb for their needs, it would address the perceived parking barrier.

When asked what their preference would be for a mode of public transportation, respondents overwhelmingly chose light rail as their top choice, followed by an electric streetcar/tram/trolley system. This applies whether the respondents were residents of Des Moines or the suburbs, and whether the respondents worked within the city or the suburbs.

First choice of public transportation system by location of residency

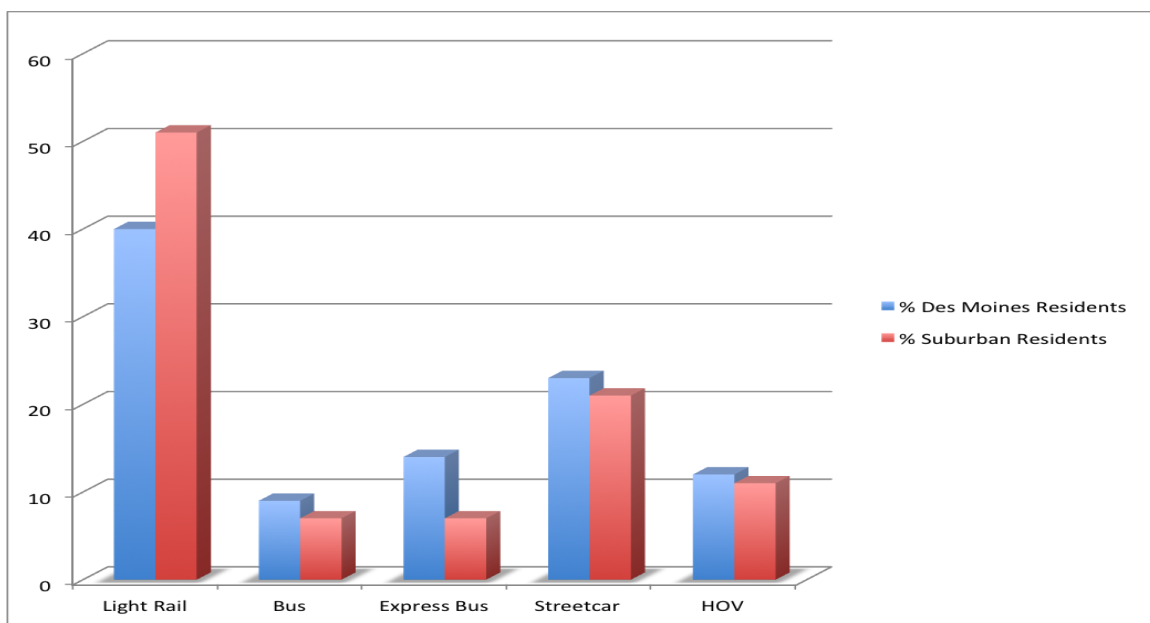


Figure 22. Comparison of the first choice of public transportation methods between urban and suburban residents.

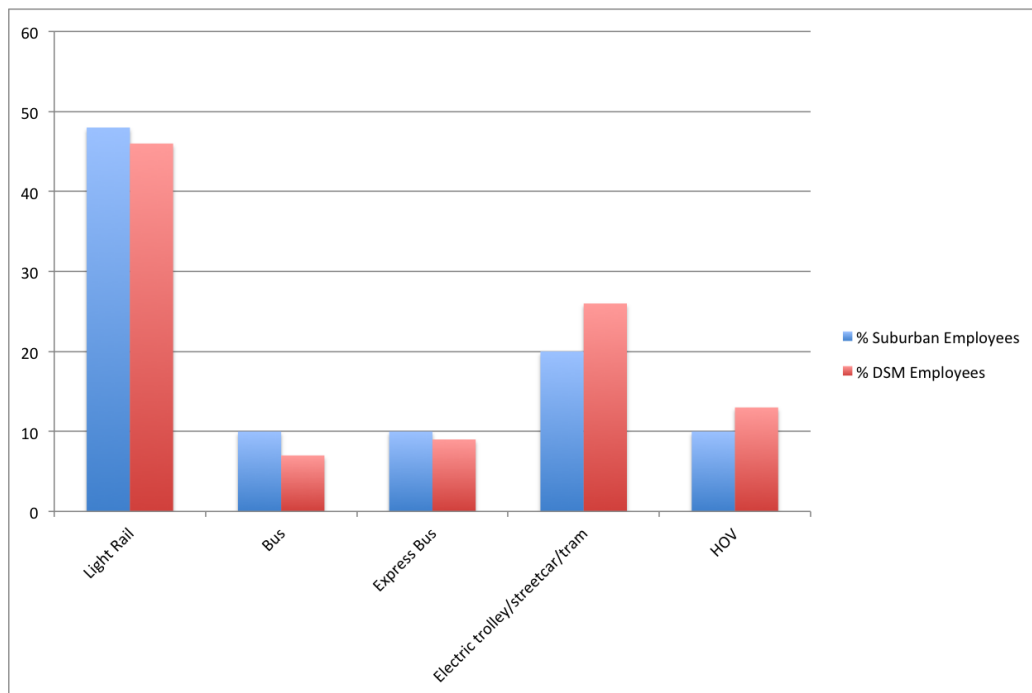
First choice of public transportation system by location of employment

Figure 23. Comparison of the first choice of public transportation methods between participants who work in the city vs. the suburbs.

Respondents eschewed bus systems and carpool lanes, which are generally lower-risk and lower-investment options.

However, while the results to the above questions suggest that both urban and suburban residents would favor the implementation light rail or electric streetcar mass transit options, their willingness to actually utilize the system regularly is much less clear.

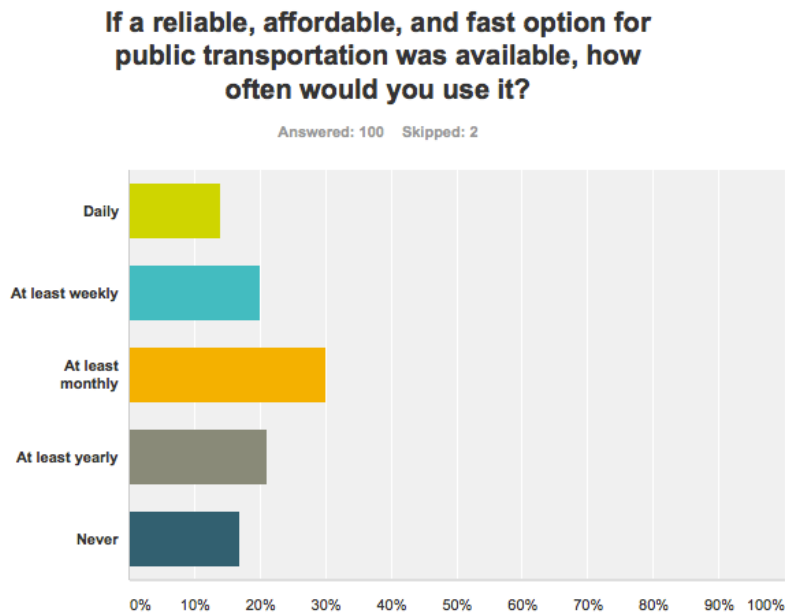


Figure 24. Less than 35% of respondents estimate that they would utilize public transportation at least weekly, even when it is assumed that the system would be efficient.

With far less than half of survey participants willing to utilize the system regularly (even assuming it can achieve the reliability, affordability, and speed required), the feasibility of a mass transit system being able to achieve an economy of scale is doubtful.

Surprisingly, the age and income level of the respondents did not seem to affect their willingness to use public transportation. The correlation between frequency of use and age was slightly negative, though statistically insignificant, at -0.11.

Similarly, the correlation between frequency of use and income was slightly negative, though statistically insignificant, at -0.07. These results indicate that as age and income increase, people may be less likely to utilize public transportation regularly, though not to a significant degree.

Proposal

While many flaws exist with the current public transportation model (evidenced by lack of ridership and heavy reliance on subsidies), this paper proposes several possible solutions. However, each solution will require resources and enough support to implement. Because of this, the solution should be gradual and broken into phases. Ideally, the changes should be developed and implemented over the span of 20 years in conjunction with DART 2035.

Phase I

Increase ridership

Phase I focuses on increased ridership and the development and implementation of High Occupancy Vehicle (HOV) lanes. To do this, public transportation barriers (real or perceived) must be eliminated. Although six of the ten fastest-growing cities are in Polk and Dallas County (US Census Bureau, 2014), all six cities should not be targeted for improvement. Instead, “prime” cities should be selected and tested. A prime city could be defined a number of ways: total population, population density, distance/travel time to downtown Des Moines, demographics, ease of implementation, and so forth. For example, Ankeny, Iowa could be considered a prime city not currently serviced. In fact, DART serves less than 500 Ankeny residents per day (DART, 2014). Other relevant facts about Ankeny include:

- Over 51,000 residents (2013 estimate)
- 1,554.2 people per square mile (2010 census)
- <15 minutes to downtown Des Moines using interstate
- Median household income of \$73,315 (2012 estimate)

- Three Interstate-35 exits/entrances

Based upon Polk/Dallas County vehicle registrations (outlined earlier), an assumption can be inferred: most residents of the Des Moines Metropolitan have access to—and utilize—privately owned/operated vehicles; Ankeny is no different. Thus, non-riders must be the target demographic. Existing riders will continue to benefit from DART improvements, but the non-riders have to be persuaded to utilize the DART, even if only as an occasional supplement to POV use. However, the 20-year model aims to have public transportation reach a complimentary level, thus, being integral to each resident of the Des Moines Metropolitan.

To do so, an aggressive campaign must be initiated that outlines: 1) actual costs of POV operation and 2) how DART is a reliable, affordable, and comparative alternative. In other words, it must compete with (or beat) the “perks” of owning and operating a POV. Even if a new rider only utilizes DART occasionally to commute to work, avoid driving during inclement weather, or on the weekends for pleasure, DART will be moving in a positive direction that will enable each phase to be successful.

HOV Lanes

High Occupancy Vehicle (HOV) lanes would be the most affordable, flexible, and easiest solution to implement. HOV lanes would be accessible only to public transportation vehicles, emergency responders, and POVs carrying a minimum of two (possibly three) people. At present, the far left lanes of I-35N/S and I-235E/W would be ideal for HOV lanes. Additionally, the lanes should only operate during peak hours. While peak hours would have to be researched further, it is reasonable to assume 0600-0900 and 1500-1800

hours. This provides a 12-hour window of coverage while minimizing the impact to non-HOV riders.

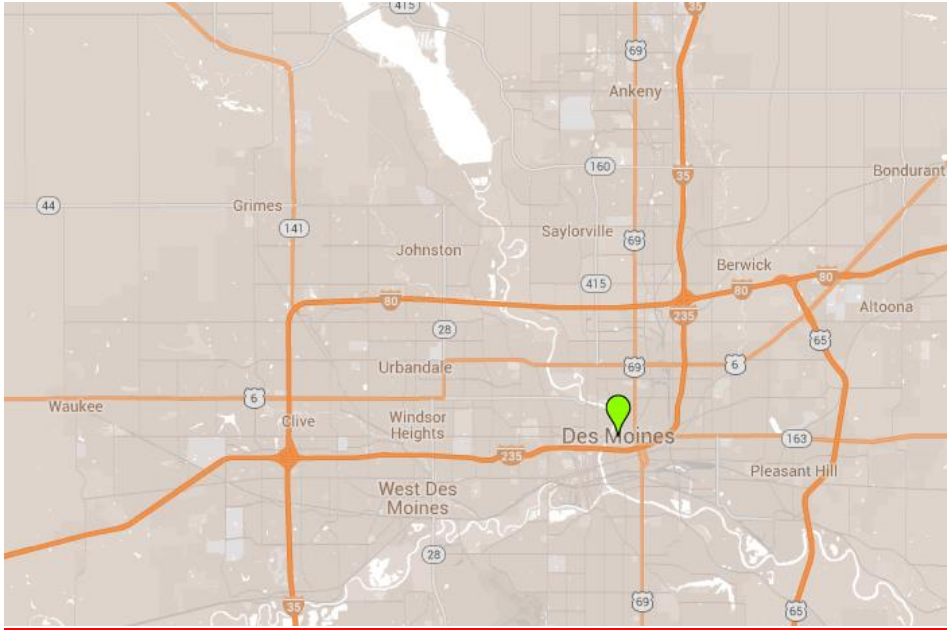


Figure 25. HOV lanes should, at a minimum, connect the western suburbs (West Des Moines, Urbandale, Johnston, Clive, Grimes, and Waukee), the northern suburb of Ankeny, and the eastern suburb of Altoona. HOV lanes must extend from pick-up site to DSM exits.

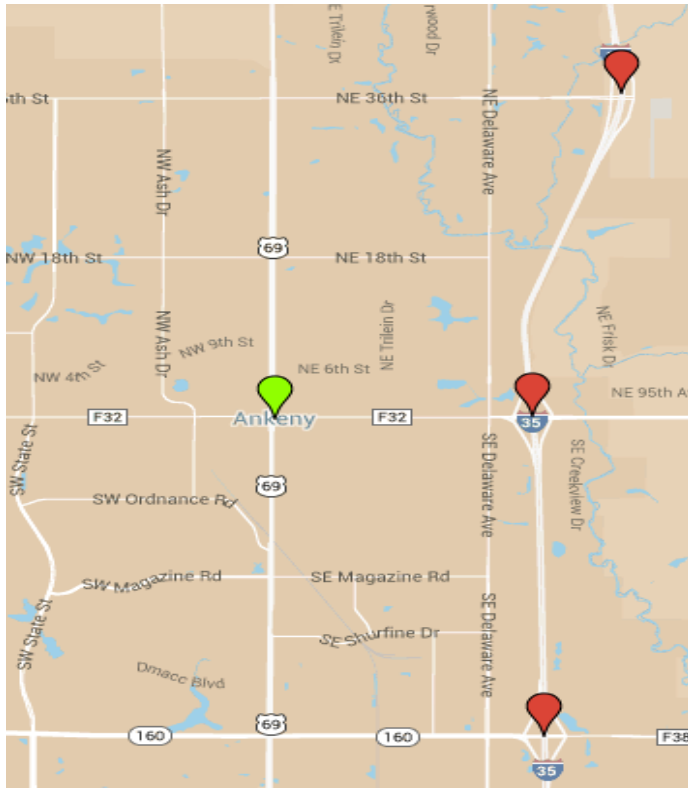


Figure 26. The green balloon represents Ankeny city center. The red balloons represent I-35S exits/on-ramps. The HOV lanes must extend all the way through each city to reduce travel delays.

Phase II

Increase ridership

Assuming a favorable Phase I implementation, Phase II must focus on continued efforts at increasing ridership; specifically through furthering value-based analysis and comparison on private versus public transit, and increasing DART option(s) and convenience. With the growing data culture, DART must continue to employ statistical analysis of usage rates and bus passenger loads stratified by stop location. By utilizing these usage statistics DART can better target the markets and stops that are seeing the most passenger traffic and adjust their routes accordingly to better serve their population and increase convenience and utility. DART has outlined similar ideas of increased service to more high-traffic areas, along with weekend service on selected routes and

more peak and off-peak hour “express” trips/rides in their long-term plan (Dart 2014). Increased ridership will also be an advocate for increased infrastructure, which will promote the expansion of not only physical DART infrastructure but also future DART projects and mass transit utilities such as LRT. Phase II will also further promote the use of a “multi-hub” DART system, linking customers to multiple DART services such as express ride, on-call services, ride-sharing, and shuttles (Dart 2014). This system will allow riders to seamlessly transition between multiple DART services better serving their mass transit needs as they travel to and from Des Moines for work or entertainment from any of the surrounding communities. This will become the base for the “multi-hub” hub and spoke model, which will be fully envisioned and implemented in Phase III.

Phase III

Phase III will look to solidify the hub-and-spoke model of transit with facilitation from DART along with implementation and usage of new transit systems such as light rail and/or streetcar. With an established hub-and-spoke system providing consistent service to riders in surrounding suburbs and locales close to Des Moines, the transit authority, along with the help of private interests and federal/state funding, can look to expand transit options and provide more destination services to previously unserved areas. We have already examined the feasibility of a light rail system in the Des Moines metro, connecting suburbs with the downtown; the next possible utilization of this light rail system would be to further promote the “multi-hub” hub-and-spoke model and create light rail stations at the outer ring circling downtown Des Moines. This would effectively allow commuters to travel between surrounding areas of Des Moines without having to go through the center of the city.

Also, this would provide more options for residents who live in Ankeny, for example, but work in Urbandale, who may not want to travel through Des Moines or use bus-transit. With the coordinated efforts of DART and the surrounding hubs, this model could effectively allow commuters to transition between transportation modes while having access to both downtown and the surrounding suburbs of Des Moines and provide multiple routes to further increase convenience and utility. The purpose of this model is to provide as many effective and desirable options as possible, and with the combined use of bus transit, HOV lanes, the hub-and-spoke model, and possible LRT/streetcar transit, make nearly every destination in Des Moines or the surrounding suburbs accessible by public or mass transit.

Conclusion

The DART Forward 2035 strategy is a step in the right direction, but it doesn't go far enough to truly connect the city and the suburbs. In order to overcome the challenges of a transportation system currently dominated by personal vehicles and roadways, the metro adopt a more robust strategy. By adding low-risk options such as HOV lanes and implementing a "multi-hub" hub-and-spoke model to extend the system's reach into the suburbs, the current DART bus system can better serve the metro. But for Greater Des Moines' public transportation to be modernized, environmentally sustainable, and poised for growth, DART and the DMAMPO should consider implementing an electric streetcar and/or light rail system to connect the suburban hubs to the city center. This will require a gradual shift in attitudes and culture of the area residents, as our survey results indicate that while people may support the idea of light rail and electric streetcars, they are currently unlikely to actually use it with any frequency.

References

- AAA. (2013). *Your driving costs: how much are you really paying to drive?* Retrieved from <https://exchange.aaa.com/wp-content/uploads/2013/04/Your-Driving-Costs-2013.pdf>
- Aaron, M. (2014, March 24). Capital Metro rolls out MetroRapid, new fares. KXAN News. Retrieved from <http://kxan.com/2014/01/26/capital-metro-rolls-out-metrorapid-new-fares/>
- American Airlines Group. (2014). *American airlines group overview*. Retrieved from <http://www.aa.com/i18n/amrcorp/corporateInformation/facts/americanairlinesgroup.jsp>
- American Lung Association. (2014). *State of the air: cleanest cities*. Retrieved from <http://www.stateoftheair.org/2014/city-rankings/cleanest-cities.html>
- Andrew, M. (2014, April 3). 10 Undercover Stylish Neighborhoods in the US. *Paste Magazine*. Retrieved from <http://www.pastemagazine.com/blogs/lists/2014/04/10-undercover-stylish-neighborhoods.html>
- Aschbrenner, J. (2014). Airport terminal plans hinge on passenger growth. *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/business/development/2014/07/13/des-moines-airport-terminal-plans/12589521/>
- Aschenbrenner, J. (2014, April 11). Downtown Des Moines a home for headquarters. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/business/2014/04/12/des-moines-downtown-development-kum-go-west-des-moines-suburbs-renaissance-western-gateway-pappajohn-krause-park/7631949/>
- Badenhausen, K. (2014, July 23). Best And Worst Places For Business 2014. *Forbes*. Retrieved from <http://www.forbes.com/pictures/mli45ejmjg/best-places-2-des-moines-iowa/>
- Capital Metropolitan Transportation Authority. (2014). About Capital Metro. Retrieved from <https://www.capmetro.org/aboutus/>

- Carlyle, E. (2014, August 18) America's 15 Best Cities For Young Professionals. *Forbes*. Retrieved from <http://www.forbes.com/sites/erincarlyle/2014/08/18/americas-15-best-cities-for-young-professionals/>
- Centers for Disease Control and Prevention. (2014). *Costs and prevention policies*. Retrieved from <http://www.cdc.gov/motorvehiclesafety/costs/>
- Christie, Les (2007, June 28). The fastest growing U.S. cities. *CNNMoney*. Retrieved from http://money.cnn.com/2007/06/27/real_estate/fastest_growing_cities/
- City of Altoona. (2014). Welcome to Altoona, Iowa. Retrieved from <http://www.altoona-iowa.com/i-want-to/residential-tax-abatement/>
- CNN Money. (2014). *The runway to the final four*. Retrieved from <http://money.cnn.com/infographic/news/companies/airline-merger/>
- Conaway, F. & Associates. (2008). Des Moines, Iowa Initial Feasibility Assessment, Downtown Streetcar System. Retrieved from <https://www.dmgov.org/Departments/CommunityDevelopment/PDF/StreetcarSuitabilityStudy041408.pdf>
- Cook, G., & Goodwin, J. (2008). Airline Networks: A comparison of Hub-and-Spoke and Point-to-Point Systems Airline Networks. *The Journal of Aviation/Aerospace Education & Research*, 17(2). Retrieved from <http://commons.erau.edu/cgi/viewcontent.cgi?article=1443&context=jaaer>
- Cosmas, A. & Martini, B. (2007). *UPS and fedex air hubs: comparing louisville and memphis cargo hub operations*. Retrieved from http://ardent.mit.edu/airports/ASP_exercises/ASP%20matl%20for%20posting%202007/UPS%20and%20FedEx%20Hub%20Operations%20Cosmas%20Martini.pdf
- Delta Airlines. (2014). *Delta airlines route map* [digital image]. Retrieved from <http://www.delta.com/content/dam/delta-www/pdfs/route-maps/us-route-map.pdf>
- Delta Airlines. (2014). *History*. Retrieved from <http://news.delta.com/index.php?s=20308&cat=3197>

- Delta Airlines. (2014). *Stats & facts*. Retrieved from <http://news.delta.com/Stats-Facts>
- Des Moines Area Regional Transit Authority. (2014). *FY2015 budget: connecting communities, connecting opportunities*. Retrieved from <http://www.ridedart.com/sites/default/files/about-dart/FY15%20BUDGET%20BOOK.pdf>
- Des Moines Area Regional Transit Authority. (2014). System overview. Retrieved from <http://www.ridedart.com/system-overview>
- DeWitte, D. (2014, October 2). Transit or transportation, funding's a problem. *Corridor Business Journal*. Retrieved from <http://www.corridorbusiness.com/news/transit-or-transportation-fundings-a-problem-in-iowa/>
- Downtown Planning Project Steering Committee. (2008). What's Next, Des Moines? Retrieved from <https://www.dmgov.org/Departments/CommunityDevelopment/PDF/DowntownPlanSection0.pdf>
- Dunbar, W. (2014, March 24). Is Capital Metro's New MetroRapid Service Leaving Bus Riders Behind? *KUT News*. Retrieved from <http://kut.org/post/capital-metros-new-metrorapid-service-leaving-bus-riders-behind>
- Eggert, A. (2010, September 20). U transit system gains recognition. *Minnesota Daily*. Retrieved from <http://www.mndaily.com/2010/09/20/u-transit-system-gains-recognition>
- Encyclopaedia Britannica. (2014) Minneapolis: The contemporary city. Retrieved from <http://www.britannica.com/EBchecked/topic/384311/Minneapolis>
- Environmental Protection Agency. (2014). *Health effects of air pollution*. Retrieved from <http://www.epa.gov/region07/air/quality/health.htm>
- FedEx. (2014). *FedEx facts*. Retrieved from <http://about.van.fedex.com/fedex-facts>
- Fruth, W. (2014). Economic Strength Rankings - 2014. *Policom*. Retrieved from <http://www.policom.com/2014%20MetroRank.htm>
- Gallagher, L. (2014, July 21). Fortune names Des Moines No. 1 'up-and-coming' downtown. *Fortune*. Retrieved from

- <http://fortune.com/video/2014/07/10/5-cities-with-up-and-coming-downtowns/>
- Gallup Healthways Well-being Index. (2014). State of American Well-Being. Retrieved from <http://info.healthways.com/wellbeingindex>
- Garner, S. The 10 Best U.S. Job Markets in 2014. *ZipRecruiter Post*. Retrieved from <https://www.ziprecruiter.com/blog/2014/04/02/the-best-job-markets-in-2014/>
- Gregor, K. (2010, April 16). Cap Metro: The Quarter Cent Shuffle. *Austin Chronicle*. Retrieved from <http://www.austinchronicle.com/news/2010-04-16/1016848/>
- Gregor, K. (2010, April 16). Gone and Quartered: Stiffed on Capital Metro money, the city scrambles to fund another \$51 million for transportation projects. *Austin Chronicle*. Retrieved from <http://www.austinchronicle.com/news/2010-04-16/1016842/>
- Iowa Department of Transportation. (2013). [Data File]. *Calendar year 2013 vehicle registrations summary*. Retrieved from <http://www.iowadot.gov/mvd/ovs/regis2013.pdf>
- Iowa Department of Transportation. (2014). *2007-2011 Crash history: all rural crashes polk county iowa*. Retrieved from http://www.iowadot.gov/crashanalysis/data/county/general/_counts/counts20072011/featurecounts/pdfs/polk20072011.pdf
- Iowa Department of Transportation. (2014). Iowa transit history. Retrieved from <http://www.iowadot.gov/transit/history.html>
- Iowa Department of Transportation. (2014). Federal transportation funding in Iowa. Retrieved from http://www.iowadot.gov/pol_leg_services/fed_trans_funding.html
- Iowa transit seeks increased funding. (2014, March 26). *Mason City Globe Gazette*. Retrieved from http://globegazette.com/iowa-transit-seeks-increased-funding/article_fe26daac-5e8a-582d-af17-00d1626e5169.html
- Lei, T. L. (2013). Identifying Critical Facilities in Hub-and-Spoke Networks: A Hub Interdiction Median Problem Identifying Critical Facilities in Hub-and-Spoke

- Networks: A Hub Interdiction Median Problem. *Geographical Analysis*, 45(2), 105-122. doi:10.1111/gean.12006
- Lincoln Metropolitan Planning Organization. (2011). 2040 Long Range Transportation Plan. Retrieved from <https://www.lincoln.ne.gov/city/plan/long/lrtp.htm>
- Litman, T. (2012, January 16). Rail Transit In America: A Comprehensive Evaluation of Benefits. *Victoria Transport Policy Institute*. Retrieved from <http://www.vtpi.org/railben.pdf>
- MarketWatch. (2014, August 3). 10 best cities for millennials to buy a home. *Marketwatch.com*. Retrieved from <http://www.marketwatch.com/story/10-best-cities-for-younger-home-buyers-2014-07-29?dist=afterbell>
- McIntyre, D. (2014). Toyota: the world's most profitable car company. *24/7 Wall Street* Retrieved from <http://247wallst.com/autos/2014/02/04/toyota-the-worlds-most-profitable-car-company>
- Meinch, Timothy. (2014, August 4) Foresight pays off in Jordan Creek development. *Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/news/2014/08/04/foresight-pays-jordan-creek-development-west-des-moines/13561249/>
- Metro Transit. (2014). About Metro Transit. Retrieved from <https://www.metrotransit.org/about-metro-transit>
- National Highway Traffic Safety Administration. (2012). *Traffic safety facts 2012: a compilation of motor vehicle crash data from the fatality analysis reporting system and the general estimates system*. Retrieved from <http://www-nrd.nhtsa.dot.gov/Pubs/812032.pdf>
- National Oceanic and Atmospheric Administration. (2014). *What are greenhouse gases?* Retrieved from <https://www.ncdc.noaa.gov/monitoring-references/faq/greenhouse-gases.php>
- Nebraska Department of Labor. (2014) Lincoln Labor Area Summary. Retrieved from http://www.dol.nebraska.gov/infolink/LaborAreaSummaries/LAS_Lincoln.pdf
- Neighborhood Scout. (2014). *Enterprise-grade data for every neighborhood city in the U.S.* Retrieved from <http://www.neighborhoodscout.com/ia/schools/>

- Nichols, J. (2014, June 11). America's Most LGBT-Friendly Cities Ranked By Vocativ's 'Queer Index'. *Huffington Post*. Retrieved from http://www.huffingtonpost.com/2014/06/11/most-lgbt-friendly-cities_n_5480806.html
- Office of the Legislative auditor State of Minnesota. (2002, March 1). Special Review Hiawatha Avenue Light Rail Transit Line. Retrieved from <http://www.auditor.leg.state.mn.us/fad/access/03-09.htm>
- Oppenhuizen, K. (2014, February 25). Index ranks Des Moines as top Midwest economy. *Business Record*. Retrieved from <http://businessrecord.com/Content/Default/-All-Latest-News/Article/Index-ranks-Des-Moines-as-top-Midwest-economy/-3/248/62455>
- Ortiz, J. (2014, January 21). The Best Places for Homeownership. *nerdwallet*. Retrieved from <http://www.nerdwallet.com/blog/cities/homeownership-2/best-places-homeownership/>
- Owen, S. (2014, April 17). Des Moines ranked No. 6 to raise a family by Forbes. *Juice*. Retrieved from <http://dmjuice.com/des-moines-ranked-no-6-to-raise-a-family-by-forbes/>
- Pennsylvania Department of Transportation. (2014). *PA commutes: alternative transportation in Pennsylvania: benefits*. Retrieved from <http://www.pacommutes.com/public-transit/benefits/>
- Perkins, E. (2014). America's 10 busiest airports from smarter travel. *Boston.Com*. Retrieved from <http://www.boston.com/business/2013/10/17/america-busiest-airports/TioCFY5lJT5TyUpTk68C9I/story.html#slide-1>
- Sandaruwan, M. (2010). The difference: hub and spoke vs. point to point. *Flightglobal Aviation Connected*. Retrieved from <http://www.flightglobal.com/blogs/the-networker/2010/12/the-difference-hub-and-spoke-vs-point-to-point/>
- Schettler, E. (2014, January 6). Greater Des Moines recognized as place to watch for sporting events. *Des Moines Register*. Retrieved from <http://blogs.desmoinesregister.com/dmr/index.php/2014/01/06/greater-des-moines-recognized-for-as-place-to-watch-for-sporting-events/article>

- Schlangenstein, M. (2014). Rollin king, co-founder of southwest airlines, dies. *Star-Telegram*. Retrieved from <http://www.star-telegram.com/2014/06/27/5934398/rollin-king-co-founder-of-southwest.html?rh=1>
- Significant Funding Issues Threaten the Future of Iowa's Public Transit System. (2014). Iowa Public Transit Association. Retrieved from <http://www.iapublictransit.com/legislative-priorities/federal-priorities>
- Southwest Airlines. (2014). *Corporate fact sheet*. Retrieved from <http://www.swamedia.com/channels/Corporate-Fact-Sheet/pages/corporate-fact-sheet>
- StarTran. (2014). History of StarTran. Retrieved from <http://lincoln.ne.gov/city/pworks/startran/history.htm>
- Sum, A., Khatiwada, I., Trubskyy, M., Ross, M., McHugh, W. & Palma, S. (2014, March 14). The Plummeting Labor Market Fortunes of Teens and Young Adults. *The Brookings Institution*. Retrieved from http://www.brookings.edu/~media/Research/Files/Reports/2014/03/14%20youth%20workforce/Youth_Workforce_Report_FINAL.pdf
- Tibbets, E. (2014). Population growth focused in central iowa. *Quad-City Times*. Retrieved from http://qctimes.com/news/local/government-and-politics/population-growth-focused-in-central-iowa/article_8986e2ac-246f-56b8-a1bc-e122c66c5ff3.html
- Tibbles, K. (2014, January 23). Des Moines, where regular folks can live the rich life. *TODAY*. Retrieved from <http://www.today.com/money/des-moines-where-regular-folks-can-live-rich-life-2D11965288>
- Toyota Motor Corporation. (2013). *Annual Report: selected financial summary (U.S. GAAP)*. Retrieved from http://www.toyota-global.com/investors/ir_library/annual/pdf/2013/p42_123.pdf
- U.S. Census Bureau (July 8, 2014): State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, County Business Patterns, Economic Census, Survey of Business Owners, Building Permits, Census of Governments. Retrieved from <http://quickfacts.census.gov/qfd/states/19/1921000.html>

- U.S. Centennial of Flight Commission. (2014). *American airlines*. Retrieved from http://www.centennialofflight.net/essay/Commercial_Aviation/American/Tran15.htm
- United States Census Bureau. (2014). [Data File]. *State and county quickfacts*. Retrieved from <http://quickfacts.census.gov/qfd/states/19/1979950.html>
- United States Department of Transportation. (2014). [Data File]. *Table 2-1: Transportation fatalities by mode*. Retrieved from http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_02_01.html_mfd
- University of Phoenix. (2014). *Campus locations*. Retrieved from <http://www.phoenix.edu/campus-locations.html>
- University of Texas at Austin. (2014). UT Parking and Transportation Services. Retrieved from <http://www.utexas.edu/parking/>
- Wear, B. (2008, September 30). Feds OK Cap Metro's passenger rail cars. *The Austin American-Statesman*. Retrieved from <http://www.statesman.com/news/content/news/stories/local/09/30/0930capmetro.html/>
- Wear, B. (2010, January 28). Capital Metro Balks at Paying Debt to City. *Austin American-Statesman*. Retrieved from <http://www.statesman.com/news/news/local/cap-metro-balks-at-paying-debt-to-city-1/nRhQP/>
- Wyher, T. (2014, June 12). The Top Six Most Family Friendly U.S. Cities. *RealtyTimes*. Retrieved from <http://tw.realtytimes.com/advicefromagents1/item/28963-the-top-6-most-family-friendly-u-s-cities>